User Manual

Allen-Bradley

CHPS-Series Linear Stage

Catalog Numbers CHPS-150, CHPS-200, CHPS-250

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the changes made to this revision.

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Corrected catalog numbers	18, 29, 59, 60, 87
Added maximum velocity for Kinetix 6500 and Kinetix 300 Drives	74

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Read this preface to familiarize yourself with the manual.

About This Publication

This manual provides detailed installation instructions for mounting, wiring, maintaining, and troubleshooting your CHPS-Series Linear Motor Driven Stage.

Who Should Use This Manual

This manual is intended for engineers or technicians directly involved in the installation, wiring, and maintenance of stages. Any person that teaches, operates, maintains, or repairs these stages must be trained and demonstrate the competence to safely perform the assigned task.

If you do not understand the linear motor stages, contact your local Rockwell Automation sales representative for information on training courses before using this product.

Read this entire manual before you attempt to install your stage into your motion system. This familiarizes you with the stage components, their relationship to each other and the system.

After installation, check the configuration of the system parameters to be sure they are properly set for the stage in your motion system.

Follow all instructions carefully and pay special attention to safety concerns.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
High Precision Linear Motor Driven Stages Selection Guide, publication CHPS-SG001	Provides product specifications, ratings, certifications, system interface, and wiring diagrams to aid in product selection.
Kinetix® 2000 Multi-axis Servo Drive User Manual, publication 2093-UM001	Describes how to configure and use Kinetix 2000 multi-axis servo drives.
Kinetix 6000 Multi-axis Servo Drive User Manual, publication 2094-UM001	Describes how to configure and use Kinetix 6000 multi-axis servo drives.
LZ Family of Linear Motors Brochure, publication PMC-BR001	Provides product specifications, outline drawing, ratings, and wiring information to aid in product selection.
LC Family of Linear Motors Brochure, publication PMC-BR002	Provides product specifications, outline drawing, ratings, and wiring information to aid in product selection.

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Stage Safety

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IMPORTANT Any person that teaches, operates, maintains, or repairs these linear stages must be trained and demonstrate the competence to safely perform the assigned task.

Safety Labels

To prevent injury and damage to the stage, review the safety labels and their warning details and location before using the stage.

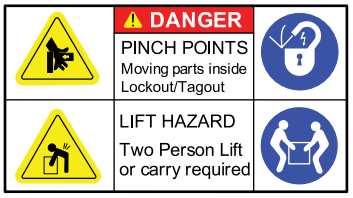
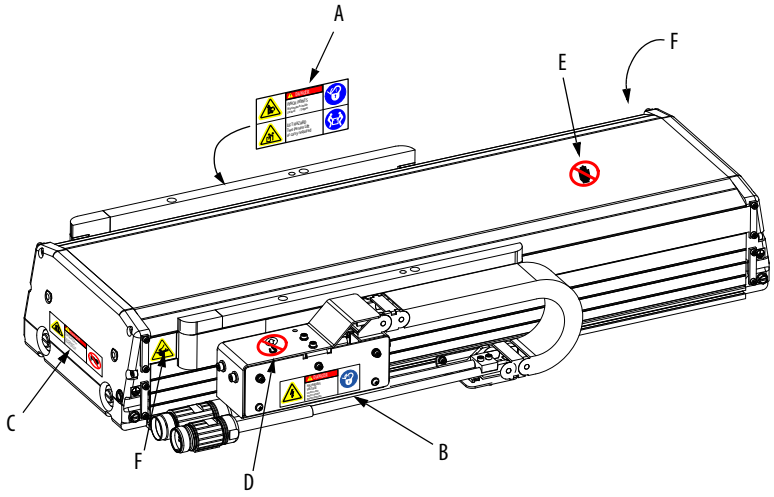
Location	Title	Label	Details
A	Danger-Pinch Points and Heavy Objects		The linear stage presents a muscle strain hazard if one person attempts to lift it. When attempting to move the linear stage use a two-person-lift to prevent personal injury or damage to the linear stage. To Installer - There exists a Crush and Cut hazard while installing the linear stage. The linear stage weighs from 13…63 kg (28…140 lb). To User - The Pinch Point label identifies a moving object hazard, caused by the movement of the carriage on the linear stage. Never put fingers, hands, or limbs near the linear stage while running motion commands. Before executing any motion command, check that all maintenance tools have been removed from linear stage. All types of linear stages, especially uncovered, present a pinch point hazard. This hazard may occur if fingers or hands come between the end cap and a moving carriage. Always lift the linear stage by the base and keep fingers and hands away from the opening and edges parallel to the carriage.
B	Danger-Hazardous Voltage		The Hazardous Voltage label identifies the junction box as a hazardous voltage area of the linear stage. To avoid injury be sure to follow Lockout-Tagout procedures before attempting maintenance on these linear stages.
C	Danger-Strong Magnets		The Strong Magnets label identifies non-ionizing radiation found in the linear stage. Magnet channels inside the linear stage are constructed with strong magnets. Strong magnets can disrupt the functionality of automatic implantable cardioverter defibrillators (AICD); people with a pacemaker should not work near the linear stage. Maintenance personnel working on the linear stage should avoid the use of metallic tools and secure items such as badge clip and other personal effects that could be attracted by the strong magnets. Strong magnets can erase magnetic media. Never allow credit cards or floppy disks to contact or come near the linear stage.
D	Do Not Lift by Junction Box		Do not attempt to move the linear stage by grasping the cable junction box. Moving the linear stage in this manner will damage the linear stage and create a pinch or crush hazard. The junction box is attached to the carriage, which is free to move. Lifting the linear stage in this manner will allow uncontrolled movement of the heavy base. Always use a two-person lift and grasp the linear stage by the base at the end caps. Always keep fingers clear of the carriage's path of travel.
E	Stay Clear		Do not put hands or objects on the linear stage cover. Doing so could deform the cover and damage the linear stage, causing excessive wear on the cover supports or scraping noises when the linear stage is in motion.
F	Sharp Edges		Always remove strip seals before removing the top or side covers. If it becomes necessary to remove the top or side covers or change the strip seal, exercise care when working near or on the strip seal. The edges of the strip seal are sharp and can cut if accidentally hit or if handled inappropriately.

Figure 1 - Warning Label Locations



See Safety Labels on page 12 to identify call out letters.

Clearances

Install the stage to avoid interference with the building, structures, utilities, other machines and equipment that can create a trapping hazard of pinch points.

Dress cables by using the Clearance Requirements diagram on page 23 as a guide. Do not cross the path of motion or interfere with the cable carrier motion.

General Safety

Stages are capable of sudden and fast motion. Always Lockout-Tagout stage systems before doing maintenance. Systems integrated with stages must contain interlock mechanisms that prevent motion while users are accessing the stage. Rockwell Automation is not responsible for misuse, or improper implementation of their equipment.

Heat

When running the stage at its maximum rating, the temperature of the slide can reach 75 °C (167 °F).

Vertical or Incline Payload

A vertically or inclined mounted stage does not maintain position with the power removed. Under the influence of gravity, the slide and its payload falls to the low end of travel. Design engineers must design in controlled power down circuits or mechanical controls to prevent the stage and its payload from being damaged when the power fails.

End Cap Impacts

The internal bumpers of the stage are designed to absorb a large impact from uncontrolled motion. The table on page 53 lists the energy that the bumpers can absorb before risking damage to the stage. The payload must be secured to the slide such that it does not sheer off in the event of an impact in excess of the bumper ratings.

The bolts securing the end caps are not be able to sustain multiple impacts and can eventually sheer. Correct the cause of the uncontrolled motion that caused the impact before continuing the use of the stage.

Air Freight Transportation

When air freighting stages special preparations and precautions must be taken. The following information outlines the basic requirements at the publication date of this document. However, regulations are subject to change and additional area or carrier restrictions can be imposed. Check with your carrier or logistics specialist regarding current local, regional, and national transportation requirements when shipping this product.

The 200 mm or a 250 mm stages contain magnetized material, as classified by International Air Transport Association (IATA) Dangerous Goods Regulations. An IATA trained individual must be involved when shipping this product via domestic or international air freight. Packing Instruction 902 provides information regarding the preparation of this product for air transportation. Follow these regulations for general marking and labeling requirements, the application of Magnetized Material Handling Labels, and instructions for preparing the Shipper's Declaration for Dangerous Goods.

As a minimum, refer to the following IATA Dangerous Goods Regulations:

- Subsection 1.5: Training
- Subsection 3.9.2.2: Classification as Magnetized Material
- Subsection 4.2: Identification as UN 2807, Magnetized Material, Class 9, Packing Instruction 902
- Subsection 7.1.5: Marking
- Subsection 7.2: Labeling
- Subsection 7.4.1: Magnetized Material Label
- Section 8: Shipper’s Declaration for Dangerous Goods

When shipped via ground in the United States, these products are **not** considered a U.S. D.O.T. Hazardous Material and standard shipping procedures apply.

Standards

Standards and requirements applicable to this product include, but are not limited to, the following:

- ANSI/RIA R15.06, Industrial Robots and Robot Systems Safety Requirements - Teaching Multiple Robots
- ANSI/NFPA 79, Electrical Standard for Industrial Machinery
- CSA/CAN Z434, Industrial Robots and Robot Systems- General Safety Requirements
- EN60204-1, Safety of Machinery. Electrical Equipment of Machines

Motor Model Identification

The nameplate lists the motor model for the stage.

Understanding Your Stage

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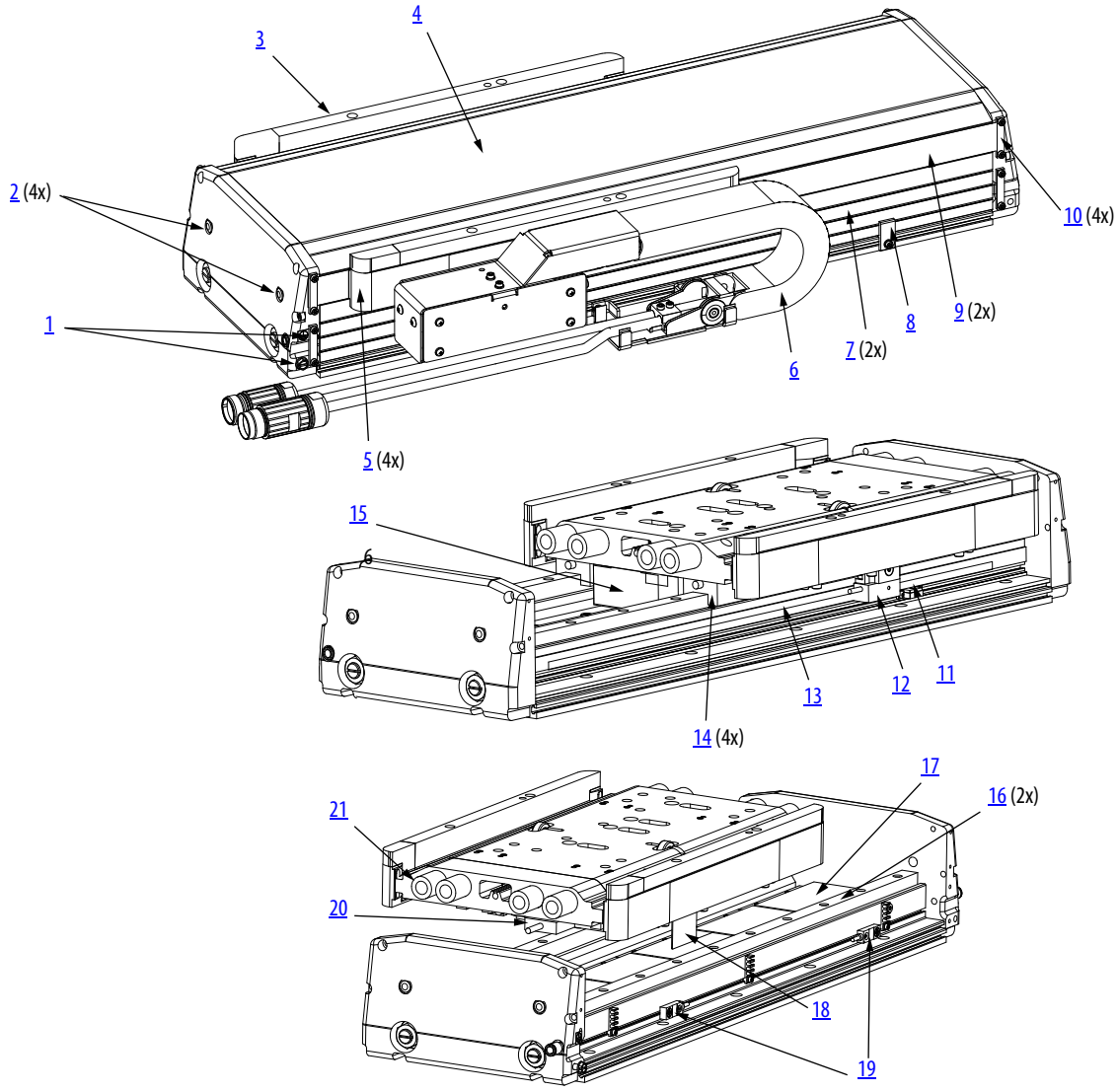
Identifying the Components of Your Stage

Use the diagrams and descriptions to identify individual stage components.

Figure 2 - Components of Your Linear Stage



Component Description

Component Number	Component	Description
1	Ground Screw and Ground Label	Use the labeled M5 x 0.8 - 6H ground screw to connect to the linear stage to a facility safety ground.
2	Bearing Lubrication Ports	These capped ports provide access to the linear bearings without dismantling the stage. In addition these tapped holes (M10 x 15. -6H) can be used to secure lifting hooks (not provided)
3	Stage Slide	Your application hardware mounts to this slide by using provide mounting holes.
4	Stage Cover	If the strip seals are used this protective cover the stage has magnetic edges to keep the upper edge of the strip seals in place.
5	Seal Guide	These guides lets the strip seal to move smoothly around the stage slide.
6	Cable Carrier Module	Facilitates quick and easy replacement. Replace the cable carrier module every 10 million cycles.
7	Stage Side Cover	If the strip seals are used this protective cover the stage has magnetic edges to keep the lower edge of the strip seals in place.
8	Side Cover Support	These supports are used on long stages to stabilize the side cover.
9	Stainless Steel Strip Seal	These replaceable, flexible stainless steel strips permit the stage to move while isolating the internal mechanism of the stage from environmental contaminants.
10	Strip Seal Clamps	These clamps hold the strip seal in place. When replacing the strip seals, they are used to position it so it lays smooth against the top and side stage covers.
11	Index Mark	Part of the encoder system that provides a home location for the encoder.
12	Optical Encoder Readhead	This encoder readhead comes in various resolutions and requires little maintenance. The TTL encoder option provides quadrature incremental position feedback with a differential signal on a RS-422. The Sine/Cosine encoder option provides a 1 volt peak-to-peak sine and cosine output at a period of 20 µm. The Sine/Cosine encoder is also known as an analog encoder.
13	Encoder Scale	Part of the encoder system that provides an optical pattern to be read by the encoder readhead. It must be kept free of contamination for proper operation.
14	Bearing	These support bearings guide the slide on the bearing rail, they require periodic lubrication.
15	Motor Coil	This coil is part of the two piece linear motor. When excited by a linear drive, it generates magnetic forces that interact with the magnet track creating motion. LC linear motor option shown. LZ linear motors have a different configuration.
16	Bearing Rail	These rails provide the linear track that the slide assembly rides on, they must be kept free of debris.
17	Magnet Track	This track of powerful static magnets is the other half of a linear motor. LC linear motor option shown. LZ linear motor option has a magnet channel.
18	Limit Blade	Provides a mechanical trigger to the limit sensor.
19	Limit Sensor	These optional sensors output a signal when the limit blade passes in front of them. The position of these sensors can be adjusted to suit your application, see Operation Guidelines and Limit Configuration section on page 49.
20	Hall Sensor Module	Three Hall sensors in this module are provide for commutation startup and phase alignment. They can also be use for trapezoidal commutation of the motor.
21	Bumper Stop	These springs absorb slide and payload energy in the event the stage loses control. See page 53 for absorption limits.

Recommended Maintenance Interval

Under normal stage use, follow these lubrication guidelines.

IMPORTANT	You determine the frequency of re-lubrication that is best suited to your application as an application's environment, motion profile, and duty cycle can effect the re-lubrication time period required.

Lubricate the stage every 6 months or 2500 km (1550 mi) of travel, which ever comes first. Use the MPAS grease gun kit and grease cartridge (catalog numbers MPAS-GPUMP and MPAS-CART respectively). See maintenance section for lubrication procedures.

Refer to Maintenance beginning on page 59 for lubrication procedures.

Identifying Your Stage

Use the following key to identify the options that your stage is equipped with. Be sure the information listed on the purchase order correlates to the information on the packing slip that accompanied your stage components. Inspect the assemblies and confirm, if applicable, the presence of specified options.

CHPS - A 6 054 A - F LM C 2 C

Bulletin Number

Voltage
- A= 230V AC

Frame Size
- 6= 150 mm base

Stroke
- Travel lengths start at 6 cm and are available in 6 cm increments.
- For example: 006 for 6 cm travel or 054 for 54 cm travel.
- Maximum travel = 120 cm.

Motor
- A= LZ-030-T-120-D
- B= LZ-030-T-240-D
- C= LZ-030-T-240-E

Feedback
- F= 1.0 micron incremental optical encoder, with integral index mark
- G= 0.5 micron incremental optical encoder, with integral index mark
- H= 0.1 micron incremental optical encoder, with integral index mark
- I= 1V p-p sine/cosine encoder, 20 µm signal period, with integral index mark

LM Specifier
- LM = Linear Motor

Protection
- S = Covered with strip seals (IP 30)[2][3]
- C = Covered without strip seals[2]
- O = Open without any cover, without strip seals

Limits
- 2 = No limits
- 5 = Two end of travel limits

Cable Management and Termination
- A = No Cables or Cable Carrier (Slide Junction Box only)
- B = Cables with Flying Leads and Cable Carrier[1]
- C = Cables with Kinetix MPF Connectors and Cable Carrier[1]
- D = Cables with D-Connectors and Cable Carrier[1]

CHPS - A 8 054 F - F LM C 2 C

Bulletin Number

Voltage

A= 230V AC

B= 460V AC (LC motors only)

Frame Size

8= 200 mm base

Stroke

For -100 and -120 motor coil lengths
Travel lengths start at 6 cm and are available in 6 cm increments.
For example: 006 for 6 cm travel or 054 for 54 cm travel.
Maximum travel = 126 cm.

Travel lengths start at 8 cm and are available in 6 cm increments.
For -200 or -240 motor coil lengths.
For example: 008 for 8 cm travel or 020 for 20 cm travel.
Maximum travel = 122 cm.

Motor

A= LZ-030-T-120-D
B= LZ-030-T-240-D
C = LZ-030-T-240-E
D= LC-050-100-D
E= LC-050-200-D
F= LC-050-200-E

Feedback

F = 1.0 micron incremental optical encoder, with integral index mark
G = 0.5 micron incremental optical encoder, with integral index mark
H = 0.1 micron incremental optical encoder, with integral index mark
I = 1V p-p sine/cosine encoder, 20 µm signal period, with integral index mark

LM Specifier

LM = Linear Motor

Protection

S = Covered, with strip seals (IP 30)[2][3]
C = Covered, without strip seals[2]
O = Open, without cover, without strip seals

Limits

2 = No limits
5 = Two end of travel limits

Cable Management and Termination

A = No Cables or Cable Carrier (Slide Junction Box only)
B = Cables with Flying Leads and Cable Carrier[1]
C = Cables with Kinetix MPF Connectors and Cable Carrier[1]
D = Cables with D-Connectors and Cable Carrier[1]

CHPS - A 9 054 G - F LM C 2 C

Bulletin Number

Voltage

A= 230V AC

B= 460V AC (LC motors only)

Frame Size

9= 250 mm base

Stroke

Travel lengths start at 8 cm and are available in 6 cm increments.
For example: 008 for 8 cm travel or 020 for 20 cm travel.
Maximum travel = 122 cm.

Motor

G = LZ-050-T-120-D
H = LZ-050-T-240-D
I = LZ-050-T-240-E
J = LC-075-100-D
K = LC-075-200-D
L = LC-075-200-E

Feedback

F = 1.0 micron incremental optical encoder, with integral index mark
G = 0.5 micron incremental optical encoder, with integral index mark
H = 0.1 micron incremental optical encoder, with integral index mark
I = 1V p-p sine/cosine encoder, 20 µm signal period, with integral index mark

LM Specifier

LM = Linear Motor

Protection

S = Covered, with strip seals (IP 30)[2][3]
C = Covered, without strip seals[2]
O = Open, without cover, without strip seals

Limits

2 = No limits
5 = Two end of travel limits

Cable Management and Termination

A = No Cables or Cable Carrier (Slide Junction Box only)
B = Cables with Flying Leads and Cable Carrier[1]
C = Cables with Kinetix MPF Connectors and Cable Carrier[1]
D = Cables with D-Connectors and Cable Carrier[1]

(1) Not for upside down mounting.
(2) Contact Applications Engineering for upside down mounting.
(3) Strip seal and covers required for wall mount applications.

Notes:

Planning the Stage Installation

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Stage Mounting Requirements

Requirements to be met when mounting your CHPS-Series stage include the following.

General Safety Standards for Stage Installations

General safety standards and requirements include, but are not limited to, the following:

- ANSI/RIA R15.06, Industrial Robots and Robot Systems Safety Requirements - Teaching Multiple Robots
- ANSI/NFPA 79, Electrical Standard for Industrial Machinery
- CSA/CAN Z434, Industrial Robots and Robot Systems- General Safety Requirements
- EN60204-1, Safety of Machinery. Electrical Equipment of Machines

Mounting Restrictions

When locating your CHPS-Series stage include the following.

- Environmental Factors
- Mounting Surface Restrictions
- Mounting Orientation
- Clearance Requirements

Environmental Factors

Factor	Applicability
Temperature	The stage does not require any special cooling considerations. Avoid mounting it near any heat generating objects, such as a heat register. Sustained average temperature must not be greater than 40 °C (104 °F), nor less than 0 °C (32 °F).
Humidity	Avoid excessive humidity. Condensation on metal surfaces can cause stage corrosion. The maximum permissible humidity is 80% relative.
Access and Interference	When possible, locate the system where sufficient working space is available to perform periodic maintenance. Avoid installing where a trapping hazard or pinch point occurs as a result of interference with the building, structures, utilities, and other machines and equipment.
Dust and airborne contaminants	Avoid placing the stage in areas where excessive dust or other airborne contaminants are present. Chemical fumes or vapors can cause damage to internal components.
Vibration	Install the stage in a location free of excessive vibration.
Ambient Light	Have sufficient light readily available to enable inspection, testing and other functions to be performed on the stage.

Mounting Surface Restrictions

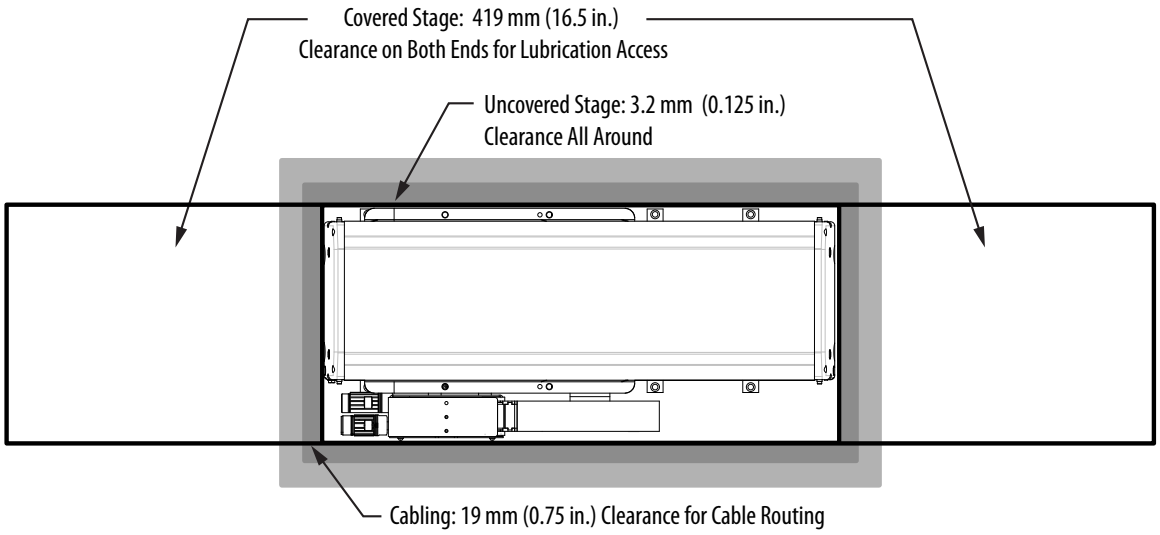
Mounting Orientation	Restriction
Surface	Stages are to be bolted or clamped to a flat, stable, and rigid surface along its entire length. Flatness deviation in the mounting surface must be less than or equal to 0.025 mm over a 300 x 300 mm (0.001 in. over a 12 x 12 in.) area. Flatness must be maintained during operation of the stage.
Ceiling - inverted surface	A ceiling mount (inverted on a horizontal surface) is not recommended. Stages mounted in this orientation are subject to premature cable carrier failure.
Wall - horizontal	Horizontal wall mount stages must be installed with the cable carrier below the stage. Stages mounted horizontally on a wall must have a travel of 1 m (3.28 ft) or less. Stages with a travel length greater than 1 m (3.28 ft) are subject to premature cable carrier failure.
Wall - vertical or incline	Stages mounted vertically on a wall must have a travel of 1 m (3.28 ft) or less. Stages with a travel length greater than 1 m (3.28 ft) are subject to premature cable carrier failure.

Clearance Requirements

The figures depict the minimum clearances for each stage type.

Power and feedback cables can impose additional clearance requirements. Refer to Interconnect Cables on page 85 for connector and bend radius requirements.

Figure 3 - Minimum Clearance Requirements


Covered Stage: 419 mm (16.5 in.)
Clearance on Both Ends for Lubrication Access
Uncovered Stage: 3.2 mm (0.125 in.)
Clearance All Around
Cabling: 19 mm (0.75 in.) Clearance for Cable Routing

Notes:

Mounting the Stage

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IMPORTANT Any person that teaches, operates, maintains, or repairs these stages must be trained and demonstrate the competence to safely perform the assigned task.

Unpacking, Handling, and Inspection

Inspect packaging to make certain no damage occurred in shipment. Document any damage or suspected damage. Claims for damage due to shipment are usually made against the transportation company. If you suspect damage, contact Rockwell Automation immediately for further advice.

Be sure the information listed on the purchase order correlates to the information on the packing slip for your stage and its accessories.

Inspect the assemblies and confirm, if applicable, the presence of specified options.

ATTENTION: Linear motor driven stages contain powerful permanent magnets that require extreme caution during handling. Do not disassemble the stage. The forces generated by permanent magnets are very powerful and can cause bodily injury.

Persons with pacemakers or automatic implantable cardiac defibrillators (AICD) must maintain a minimum distance of 0.3 m (12 in.) from magnet assemblies.

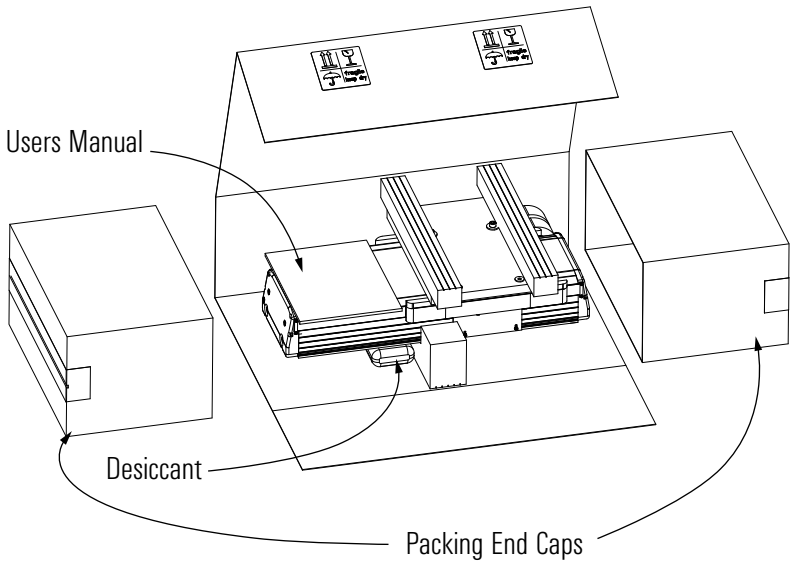
Additionally, unless absolutely unavoidable, a minimum distance of 1.5 m (5 ft) must be maintained between magnet assemblies and other magnetic or ferrous composite materials. Calipers, micrometers, laser equipment, and other types of instrumentation must be nonmetallic.

Unpacking Procedure

The following tools are recommended for unpacking the stage:

- Utility knife
- 2.5 mm, 5 mm, and 6 mm hex keys
- Packing tape

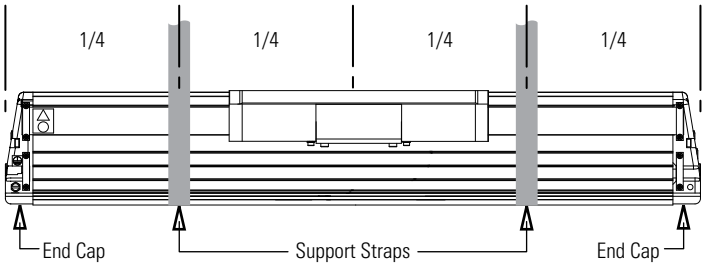
1. Place carton on flat stable surface with the tape seam side facing you.
2. Use a utility knife to score the packing tape on the edges of the carton.
3. Lift center cover to reveal the stage.



4. Remove the packing end caps.

ATTENTION: Never attempt a single-person lift. Personal injury and equipment damage can occur if the linear stage is handled improperly.

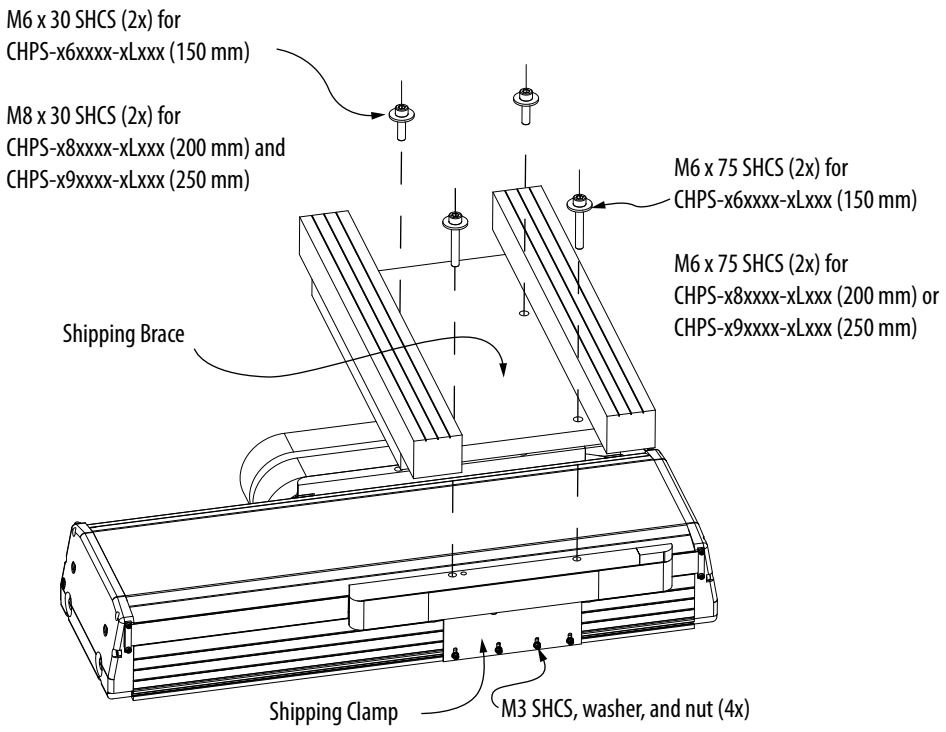
5. Remove the linear stage from the packaging supports.
   - **For stages shorter than 1 meter (39.3 in.)**, use two people and lift the linear stage by grasping the base near the end caps only.
   - **For stages 1 meter (39.3 in.) or longer**, use support straps at the 1/4 and 3/4 length points to avoid distorting the base. Use this support system whenever the linear stage must be lifted.



6. Move the linear stage to a solid support surface before removing the shipping brace.

ATTENTION: The carriage is free to move once the shipping brace is removed. Use additional care when handling the linear stage after the brace is removed. Unexpected carriage movement can cause personal injury.

7. Remove the four socket head cap screws (SHCS) from the shipping brace.
8. Lift the shipping brace off the stage and set it aside.


M6 x 30 SHCS (2x) for
CHPS-x6xxxx-xLxxx (150 mm)
M8 x 30 SHCS (2x) for
CHPS-x8xxxx-xLxxx (200 mm) and
CHPS-x9xxxx-xLxxx (250 mm)
M6 x 75 SHCS (2x) for
CHPS-x6xxxx-xLxxx (150 mm)
M6 x 75 SHCS (2x) for
CHPS-x8xxxx-xLxxx (200 mm) or
CHPS-x9xxxx-xLxxx (250 mm)
Shipping Brace
Shipping Clamp
M3 SHCS, washer, and nut (4x)

9. Remove the plastic wrap enclosing the stage and set it aside.
10. Remove the four SHCS that secure the shipping clamp.

11. Remove the four square nuts loosened in the previous step, by sliding each nut to the end of channel.

Store Packaging Material

Keep the carton in case the unit needs to be returned for warranty service or stored for an extended period of time.

1. Tape screws and clamp hardware to the shipping brace.
2. Put end caps in their original positions on the center cover and place all packing material inside the carton.
3. Lightly tape carton closed and store in dry place.

Stage Storage

Store the stage in area that is clean, dry, vibration free, and at a relatively constant temperature. Refer to Environmental Specifications for CHPS-Series Stage on page 75 for more detailed information.

Mounting the Stage

This section discusses mounting methods for your stage.

Before You Begin the Mechanical Installation

The machine designer is most qualified to determine the number and type of fasteners to use for mounting the stage. The following information is a guide for the decision-making process.

Determine the Number of Fasteners Required

The length of the stage determines the number of mounting fasteners that are required.

Use one of the following equations to calculate the required mounting hardware.

Figure 4 - Fasteners Required for Stages with 150 mm and 200 mm frame size (CHPS-x6xxxx-xLMxxx and CHPS-x8xxx-xLMxxx)

$$\text{fasteners} = \left(\left(\frac{\text{stroke (cm)} + 26\text{ (cm)}}{12}\right)\text{round down} + 1\right) \times 2$$

Figure 5 - Fasteners Required for Stages 250 mm frame size (CHPS-x9xxx-xLMxxx)

$$\text{fasteners} = \left(\left(\frac{\text{stroke (cm)} + 30\text{ (cm)}}{12}\right)\text{round down} + 1\right) \times 2$$

or example, if you are mounting an CHPS-B8194F-ALM02C stage.

$$1940 \text{ mm stroke length} = 194.0 \text{ cm}$$

$$\text{fasteners} = \frac{194 \text{ cm} + 36}{12} = \frac{230}{12} = 19.167$$

$$\text{round down} = 19$$

$$\text{fasteners} = 19 + 1 = 20 \times 2 = 40 \text{ fasteners}$$

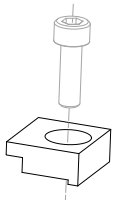
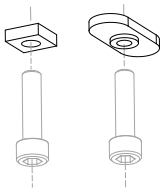
Determine the Type of Fastener to Use

Three types of fasteners that can be used to mount the stage.

- Through bolts
- Toe clamps
- Tee nut or square nut

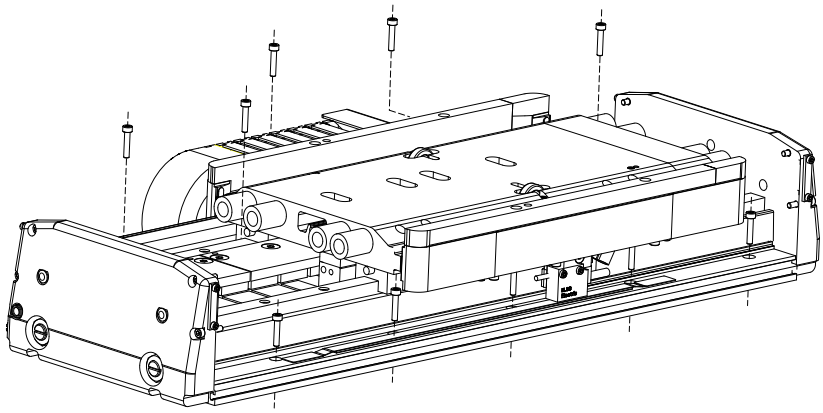
Toe clamps are supplied with the catalog number CHPS-*x6xxx* stages, and covered types of the catalog number CHPS-*x8xxx* and CHPS-*x9xxx* stages. Refer to the Mounting Fastener Options table for an illustration of each fastener type.

Table 1 - Mounting Fastener Options

Fastener	Order	Illustration	User Supplies(4)	Recommended For	Torque N•m (lbf•in)
Through Bolt(1)	–		M5 x 1.0 x 16 mm min	Uncovered stages	2.3 (30)
Toe clamps	MPAS-TOE		M6 x 1.0 x 16 mm min	Covered stages	5.5 (48)
Tee nuts(2)	MPAS-*x*-TNUT(3)		M6 x1.0	Securing a stage from beneath the mounting surface.	Tee Nut 6.7 (60) Square Nut 2.3 (30)

(1) Through bolt mounting is not an option for catalog number CHPS-*x6xxxx-xLMxxx* (150 mm) stages.
(2) The tee nut mount for a catalog number CHPS-*x8xxxx-xxxxx* (200 mm) stage is a square nut in a tee slot.
(3) Where *x* is the frame size of a stage, 6 = CHPS-*x6xxxx-xxxxx* (150 mm), 8 = CHPS-*x8xxxx-xxxxx* (200 mm), 9 = CHPS-*x9xxxx-xxxxx* (250 mm).
(4) You supply the bolts.

Figure 6 - Through Bolt Mounting

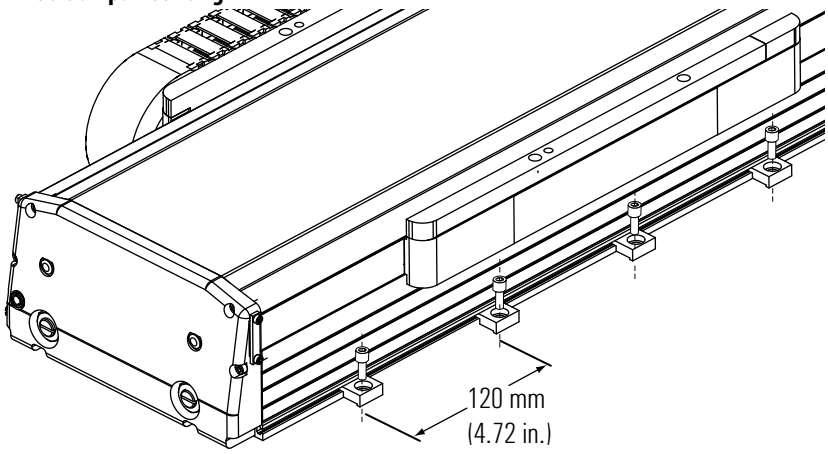


IMPORTANT Through bolt mounting is not available for the catalog number CHPS-*x6xxxx-xxxxx* (150 mm) stages.

An uncovered stage is a good candidate for through bolt mounting.

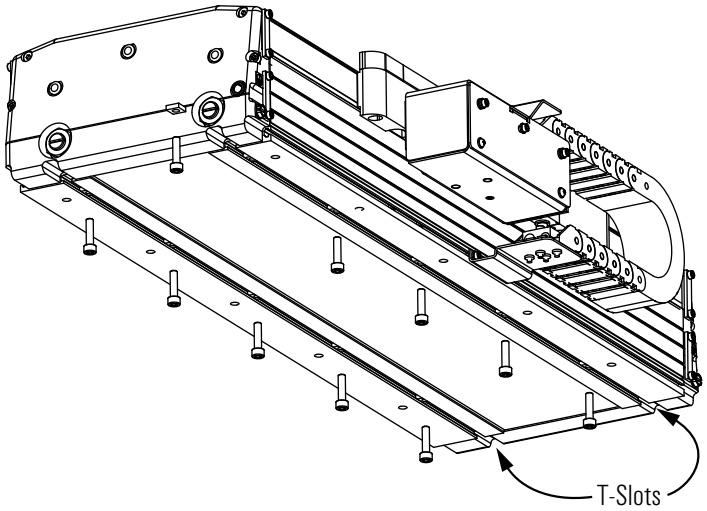
For covered stages, toe clamps are the easiest method for mounting. On sides of the base secure a toe clamps every 120 mm (4.72 in) by using M6 SHCS as shown in the Toe Clamps Mounting diagram. Use slots formed into outside edge of the stage base.

Figure 7 - Toe Clamps Mounting



Tee nuts are used to mount the stage from underneath. Insert the tee nuts every 120 mm (4.72 in.) in tee slots on the bottom of the unit. Secure the tee nuts by using M6 SHCS as shown in Tee Nut Mounting diagram.

Figure 8 - Tee Nut Mounting



Mounting the Stage

Follow these steps to install a stage on its mounting surface.

1. Be sure the mounting surface is clear of any and all foreign material.

IMPORTANT Do not use abrasives to clean the surface.

If necessary, stone the mounting surface (acetone or methanol can be applied as cleaning agent).

2. Verify that the flatness of the surface that the stage is to be mounted.

The total indicator reading (TIR) is 0.0254 mm (0.001 in.) per 300 mm (120 in.). TIR or runout, correlates to an overall flatness of a surface.

3. Lift the stage onto the prepared mounting surface

ATTENTION: Do not attempt to move the stage by grasping the cable junction box. Moving the stage in this manner can damage the stage and create a pinch or crush hazard. The junction box is attached to the carrier that is free to move. Lifting the stage in this manner causes uncontrolled movement of the heavy base. Always use a two person lift and grasp the stage by the base at the end caps keeping fingers clear of the carrier's path of travel.

The two lubrication ports on each end cap (four total) are M10 x1.5 tapped through holes and can be used to install lifting hooks supplied by the customer.

Personal injury and equipment damage can occur if stage is handled improperly.

4. Align the stage on the mounting surface, and insert the correct number of mounting bolts. Refer to CHPS-Series Stage Dimensions beginning on page 77 for detailed mounting dimensions.
5. Secure the stage by using all mounting holes. Torque bolts to the values shown in the Mounting Fastener Options table on page 29.

Mount Your Application

Mount your application to the slide by using the following bolts and torque values:

Cat. No.	Bolt	Torque N•m (lb•in)
CHPS-x6xxxx-xLMxxx	M6	3.2 (48)
CHPS-x8xxxx-xLMxxx	M8	10.1 (90)
CHPS-x9xxxx-xLMxxx	M8	10.1 (90)

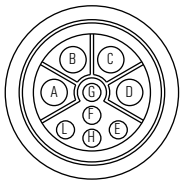
Connector Data

Topic	Page
Kinetix Servo Drive Compatible Connectors	34
D-Type Connectors	35
Flying Leads	36
Junction Box Connectors	37
Limit Sensor Flying Leads	38

Kinetix Servo Drive Compatible Connectors

The following tables identify the power and feedback pinouts for the Intercontec circular connectors for use with standard Allen Bradley connectors.

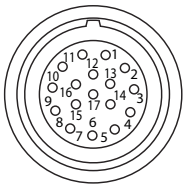
Pin	Color	Signal
A	Red	U (A) Phase
B	White	V (B) Phase
C	Black	W (C) Phase
D	Green/Yellow	Ground
Case	Shield	Cable Shield



Intercontec P/N BKUA090NN000550003500
Mating Cable: Allen-Bradley 2090-XXNPMF-16Sxx

Pin	Color Wire	With Incremental Encoder		With Analog Encoder	
		Signal Designations	Signal Description	Signal Designations	Signal Description
1	Yellow	A+	TTL - Differential	Sin+	Analog Differential 1V p-p
2	White/yellow	A-	TTL - Differential	Sin-	Analog Differential 1V p-p
3	Brown	B+	TTL - Differential	Cos+	Analog Differential 1V p-p
4	White/Brown	B-	TTL - Differential	Cos-	Analog Differential 1V p-p
5	Violet	Index Mark+	TTL - Differential	Index+	Differential Pulse 1V p-p
6	White/Violet	Index Mark-	TTL - Differential	Index-	Differential Pulse 1V p-p
7	Reserved	—	—	Reserved	—
8	Reserved	—	—	Reserved	—
9	White/Red	+5V DC	Encoder and Hall Sensor Power	+5V DC	Encoder and Hall Sensor Power
10	Black	Common	—	Common	—
11	Reserved	—	—	Reserved	—
12					
13	Green	PTC Temp+(1)	PTC Thermistor	PTC Temp+(1)	PTC Thermistor
14	White/Black	Common	—	Common	—
15	White/Green	S1	TTL - Trapezoidal Hall	S1	TTL - Trapezoidal Hall
16	Blue	S2	TTL - Trapezoidal Hall	S2	TTL - Trapezoidal Hall
17	White/Blue	S3	TTL - Trapezoidal Hall	S3	TTL - Trapezoidal Hall
Case	Shield	Shield	—	Shield	—

(1) PTC Temp- is connected to Common.

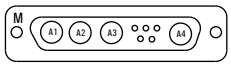


Intercontec P/N AKUA034NN00100035000
Mating Cable: Allen-Bradley 2090-XXNFMF-Sxx

D-Type Connectors

The following tables identify the power and feedback pinouts for D-shell connectors that enable custom cables to be used.

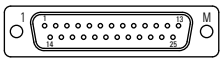
Pin	Color	Signal
A1	Red	U (A) phase
A2	White	V (B) phase
A3	Black	W (C) phase
A4	Green/Yellow	Ground
Case	Shield	Cable Shield



Positronic P/N CBD9W4M20000-1702.0
Mating Connector:
Positronic P/N CBD9W4F20000-1701.0

Pin	Color Wire	With Incremental Encoder		With Analog Encoder	
		Signal Designations	Signal Description	Signal Designations	Signal Description
1	Yellow	A+	TTL - Differential	Sin+	Analog Differential 1V p-p
2	Brown	B+	TTL - Differential	Cos+	Analog Differential 1V p-p
3	Violet	Index Mark +	TTL - Differential	Index+	Differential Pulse 1V p-p
4	White/Red	+5V DC	Encoder and Hall Sensor Power	+5V DC	Encoder and Hall Sensor Power
5	Reserved	—	—	—	—
6					
7					
8					
9	White/Green	S1	TTL - Trapezoidal Hall	S1	TTL - Trapezoidal Hall
10	Green	PTC Temp+(1)	PTC Thermistor	PTC Temp+*	PTC Thermistor
11	Reserved	—	—	—	—
12	White Blue	S3	TTL - Trapezoidal Hall	S3	TTL - Trapezoidal Hall
13	Green/Yellow	Shield	—	Shield	
14	White/Yellow	A-	TTL - Differential	Sin-	Analog Differential 1V p-p
15	White/Brown	B-	TTL - Differential	Cos-	Analog Differential 1V p-p
16	White/Violet	Index Mark-	TTL - Differential	Index-	Differential Pulse 1V p-p
17	Black, White/Black	Common	—	Common	—
18	Reserved	—	—	—	—
19					
20					
21					
22	Blue	S2	TTL - Trapezoidal Hall	S2	TTL - Trapezoidal Hall
23	Reserved	—	—	—	—
24					
25					

(1) PTC Temp- is connected to Common.



Connector Part Number AMP P/N 207464-2
Mating Connector Part Number AMP P/N 5205207-1

Flying Leads

The following tables identify the power and feedback pinouts for flying lead this option lest you to use your own connectors.

ATTENTION: Disconnect input power supply before installing or servicing stage

Stage lead connections can short and cause damage or injury if not well secured and insulated.

Insulate the connections, equal to or better than the insulation on the supply conductors.

Properly ground the stage as described in the drive manual.

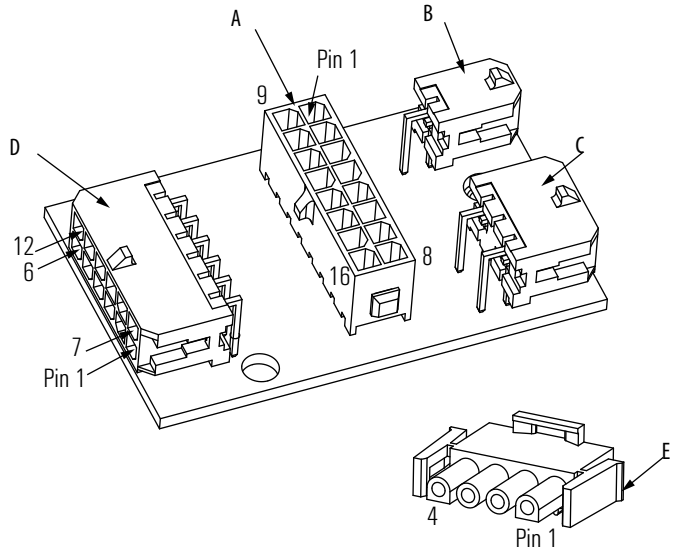
Color	Signal
Red	U (A) phase
White	V (B) phase
Black	W (C) phase
Green/Yellow	Ground
Shield	Cable Shield

Color Wire	With Incremental Encoder		With Analog Encoder	
	Signal Designations	Signal Description	Signal Designations	Signal Description
Yellow	A+	TTL - Differential	Sin+	Analog - Differential 1V p-p
White/Yellow	A-	TTL - Differential	Sin-	Analog - Differential 1V p-p
Brown	B+	TTL - Differential	Cos+	Analog - Differential 1V p-p
White/Brown	B-	TTL - Differential	Cos-	Analog - Differential 1V p-p
Violet	Index Mark+	TTL - Differential	Index+	Differential Pulse 1V p-p
White/Violet	Index Mark-	TTL - Differential	Index-	Differential Pulse 1V p-p
Red	+5V	Encoder and Hall Sensor Power	+5V	Encoder and Hall Sensor Power
White/Red	+5V	Encoder and Hall Sensor Power	+5V	Encoder and Hall Sensor Power
Black	Common	—	Common	—
White/Black	Common	—	Common	—
Green	PTC Temp+(1)	PTC Thermistor	PTC Temp+(1)	PTC Thermistor
White/Green	S1	TTL - Trapezoidal Hall	S1	TTL - Trapezoidal Hall
Blue	S2	TTL - Trapezoidal Hall	S2	TTL - Trapezoidal Hall
White/Blue	S3	TTL - Trapezoidal Hall	S3	TTL - Trapezoidal Hall
Green/Yellow	Shield	—	Shield	—

(1) PTC Temp- is connected to Common.

Junction Box Connectors

The following diagram and tables identify the power and feedback pinouts of the junction box connector, use this information to make custom cables



Item	Description
A	J1 Feedback connector, output to flex cable, Mating connector is a Molex P/N 43025-1600
B	J2 Thermistor signal connector, the input from side
C	J3 Hall signal connector, input from side
D	J4 Encoder signal connector, input from side
E	Mating power connector AMP 359780-1

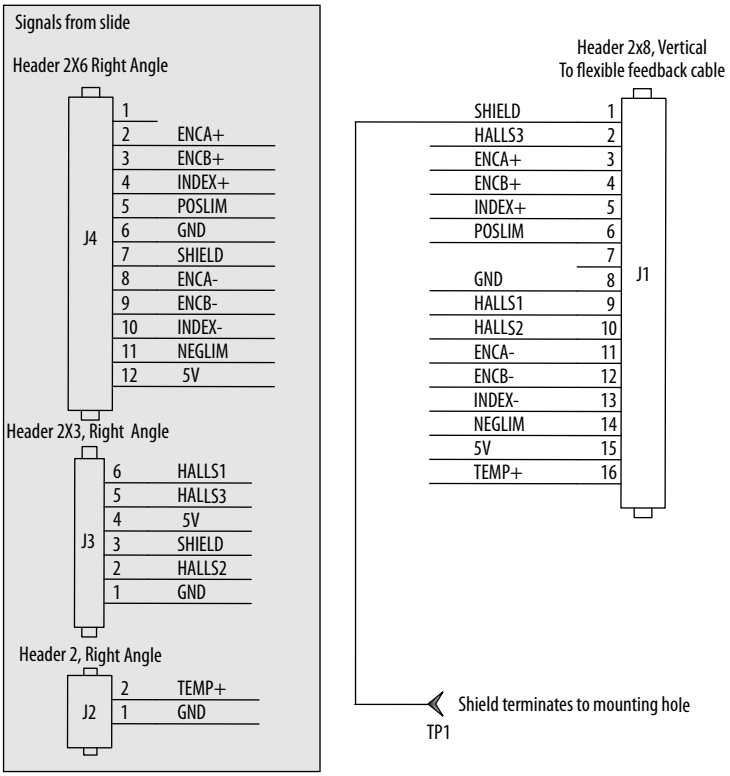


Table 2 - Junction Box Power Connector

Pin	Color	Signal
1	Red	U (A) phase
2	White	V (B) phase
3	Black	W (C) phase
4	Green/Yellow	Ground

Table 3 - Junction Box J1 Connector

Pin	With Incremental Encoder		With Analog Encoder	
	Signal Designation	Signal Description	Signal Designation	Signal Description
1	Shield	—	Shield	—
2	S3	TTL - Trapezoidal Hall	S3 -	TTL - Trapezoidal Hall
3	A+	TTL - Differential	Sin+	Analog - Differential 1V p-p
4	B+	TTL - Differential	Cos+	Analog - Differential 1V p-p
5	Index Mark+	TTL - Differential	Index+	Differential Pulse 1V p-p
8	Common	—	Common	—
9	S1	TTL - Trapezoidal Hall	S1	TTL - Trapezoidal Hall
10	S2	TTL - Trapezoidal Hall	S2	TTL - Trapezoidal Hall
11	A-	TTL - Differential	Sin-	Analog - Differential 1V p-p
12	B-	TTL - Differential	Cos-	Analog - Differential 1V p-p
13	Index Mark-	TTL - Differential	Index-	Differential Pulse 1V p-p
15	+5V	Encoder and Hall Sensor Power	+5V	Encoder and Hall Sensor Power
16	PTC Temp+(1)	PTC Thermistor	PTC Temp+(1)	PTC Thermistor

(1) PTC Temp- is connected to Common.

Limit Sensor Flying Leads

The limit sensor option comes with flying leads, regardless of the power and feedback termination option ordered.

Color	Signal Description
Brown	+V
Black	Load+
Blue	0V(1)

(1) Load- is connected to 0V.

Connecting the Stage

Topic	Page
Connecting the Stage	39
Attaching the Ground Strap and Interface Cables	40
Thermal Protection	42
Optional Limit Sensors	43
TTL Differential Encoder Output Signal	44
Sine/Cos Encoder Output Signals	45
Hall Effect Circuit	46
Motor and Hall Phasing and Sequence	46
Stage Positive Direction	48

Connecting the Stage

The installation procedure assumes you prepared your system for correct electrical bonding and understand the importance of electrical bonding for correct operation of the system. If you are unfamiliar with electrical bonding, the section Attaching the Ground Strap and Interface Cables briefly describes and illustrates correct system grounding techniques.

ATTENTION: Plan the installation of your stage so that you can perform all cutting, drilling, tapping, and welding with it removed. Be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the stage, that can result in damage to components.

SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the stage prior to applying power. Once power is applied, connector terminals can have voltage present even when not in use.

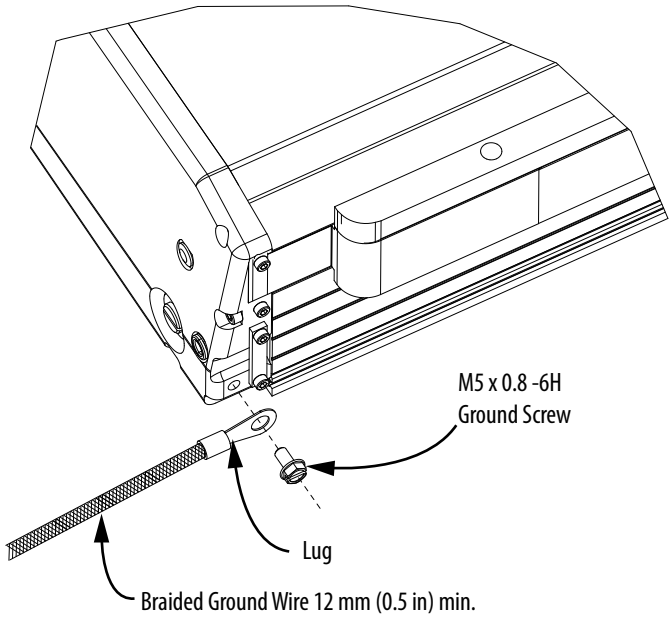
Attaching the Ground Strap and Interface Cables

The only electrical connections necessary between the stage and the drive system are the ground strap and the two cables.

1. For electrical safety, connect the ground screw on the chassis of the stage to the ground bus for your system.

   To reduce the effects of electromagnetic interference (EMI), bond the stage with a braided ground strap, 12 mm (0.5 in.) wide minimum, to a grounded metal surface. This creates a low-impedance return path for high-frequency energy.

2. Torque the ground screw at the stage to 2 N•m (18 lb•in)



3. Form a drip loop in each cable at a point directly before it attaches to the stage. Refer to the Connecting Kinetix Type Motor and Feedback Cables diagram for a visual example.

ATTENTION: Be sure that cables are installed and restrained to prevent uneven tension or flexing at the cable connectors.

Excessive and uneven lateral force at the cable connectors can result in the connector's environmental seal opening and closing as the cable flexes.

Failure to observe these safety procedures could result in damage to the motor and its components.

4. Attach the feedback cable, and the power cable to the stage.

ATTENTION: Do not connect or disconnect the stage feedback cable, or the power cable while power is applied to them.
Inadvertent pin connections can result in unexpected motion or result in irreversible damage to the components.

For Kinetix type connectors.

a. Carefully align each cable connector with the respective motor connector as shown in Figure 1.

b. Do not apply excessive force when mating the cable and stage connectors. If the connectors do not go together with light hand force, realign and try again.

ATTENTION: Be sure that cables are installed and restrained to prevent uneven tension or flexing at the cable connectors. Excessive and uneven lateral force at the cable connectors can result in the connector's environmental seal opening and closing as the cable flexes. Failure to observe these safety procedures could result in damage to the motor and its components.

c. Hand tighten the knurled collar five to six turns to fully seat each connector.

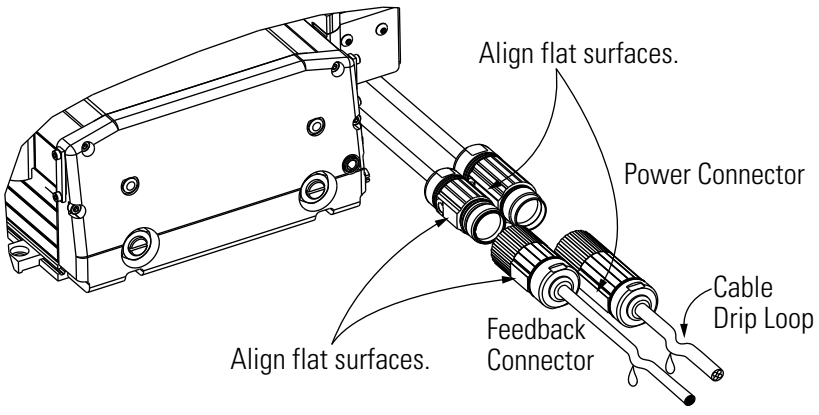
ATTENTION: Keyed connectors must be properly aligned and hand-tightened the recommended number of turns.

Improper alignment is indicated by the need for excessive force, such as the use of tools, to fully seat connectors.

Connectors must be fully tightened for connector seals to be effective.

Failure to observe these safety procedures could result in damage to the motor, cables, and connector components.

Figure 9 - Connecting Kinetix Type Motor and Feedback Cables



Thermal Protection

Connect the stage PTC thermistor signal to the drive or control system to create a thermal protection system.

PTC Thermistor Signal Characteristics	
Temperature °C (°F)	**Resistance in Ohms**
Up to 100 (212)	≤ 750
Up to 105 (221)	≤ 7500
Up to 110 (221)	≥ 10,000

ATTENTION: PTC thermistor supplies a signal that indicates the stage temperature limit condition. Connect this signal to control system or drive system so it shuts down the stage power upon reaching a limit condition. Multiple levels of stage thermal protection are strongly recommend.

The following thermal protection methods are also recommended.

- Typically digital drives use RMS current protection and or estimated temperature vs. time (I^2T) software protection schemes. Activated and set these available features according to the stage model ratings for your application.
- Set the maximum value of ± peak-current-magnitude limits of your drive to the stage's peak-current rating.
- For drives without stage protection features, install stage fuses (current rating not to exceed stage continuous RMS) according to local and National Electrical Code. Uses time-delay type fuses that are rated for the drive PWM output voltage.

Optional Limit Sensors

Two limit sensors, positive overtravel (OT) and negative OT, provide electrical protection for stage overtravel. Their physical location is shown in Component Description diagram on page 16 they and can be adjusted up to 30 mm (1.2 in.) toward the center of travel. The electric characteristics are shown here.

- Input Power: 12...28V DC, 15 mA circuit draw + 50 mA maximum sourcing = 65 mA total.
- Output: PNP, Open collector Normally Closed, 50 mA maximum sourcing.

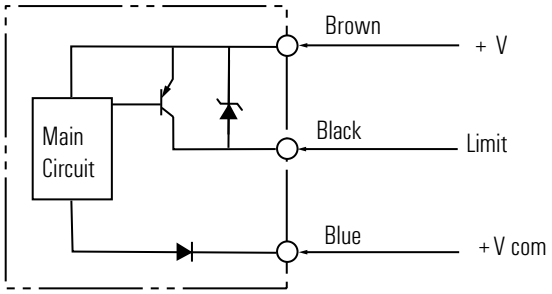
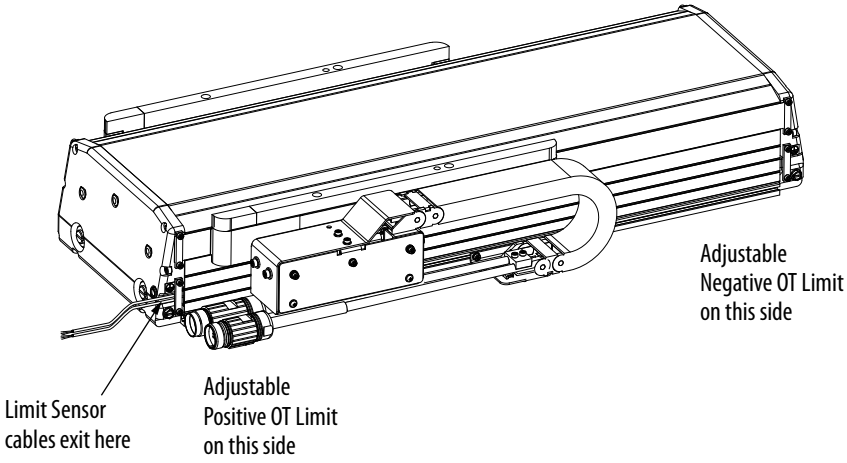


Figure 10 - Limit Sensor Orientation



TTL Differential Encoder Output Signal

Use the following information to connect a stage with a TTL Differential Encoder.

The incremental encoder typically have the following quadrature edge separation.

Encoder µm	Typical Edge Separation ns	@ Maximum Velocity[1] m/s
1	100	5
0.5	90	3
0.1	90	0.7

(1) Speeds based on 3 m maximum cable length and a minimum readhead input of 5V.

To calculate the minimum recommended counter frequency for 1 µm and 0.5 µm encoders, use the following formula.

$$\text{Counter clock frequency (MHz)} = \frac{\text{encoder velocity(m/s)}}{\text{resolution(µm)}} \times 4 \text{ (safety factor)}$$

The minimum recommend counter frequency for the 0.1 µm encoder is 12 MHz.

Figure 11 - TTL Differential Encoder Timing Diagram

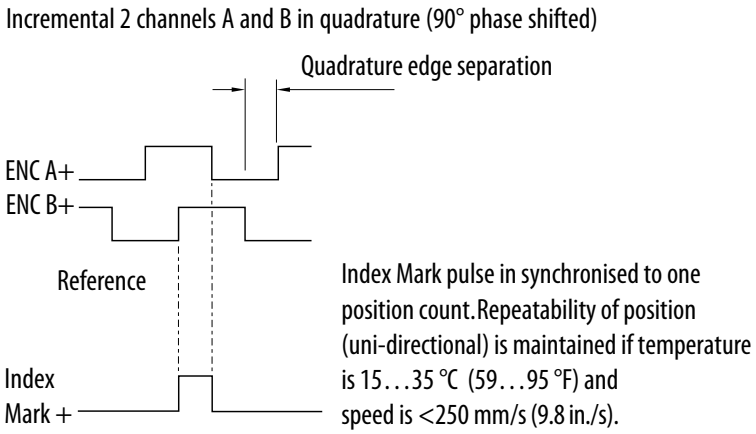
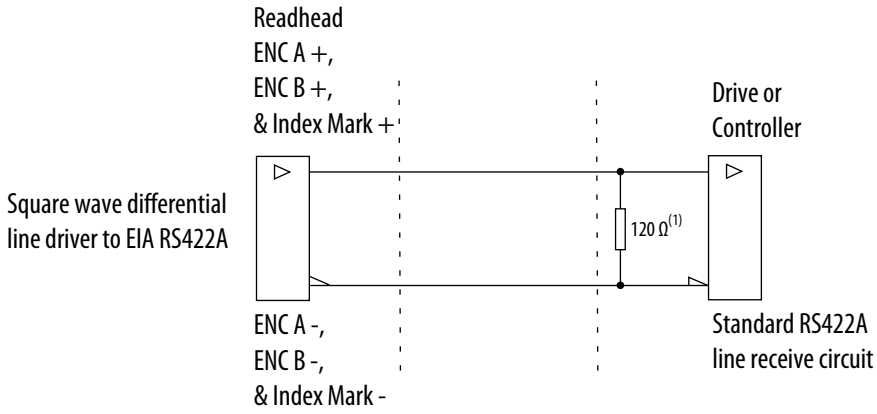

Incremental 2 channels A and B in quadrature (90° phase shifted)
Quadrature edge separation
ENC A+
ENC B+
Reference
Index
Mark +
Index Mark pulse in synchronised to one position count.Repeatability of position (uni-directional) is maintained if temperature is 15…35 °C (59…95 °F) and speed is <250 mm/s (9.8 in./s).

Figure 12 - TTL Differential Encoder Termination



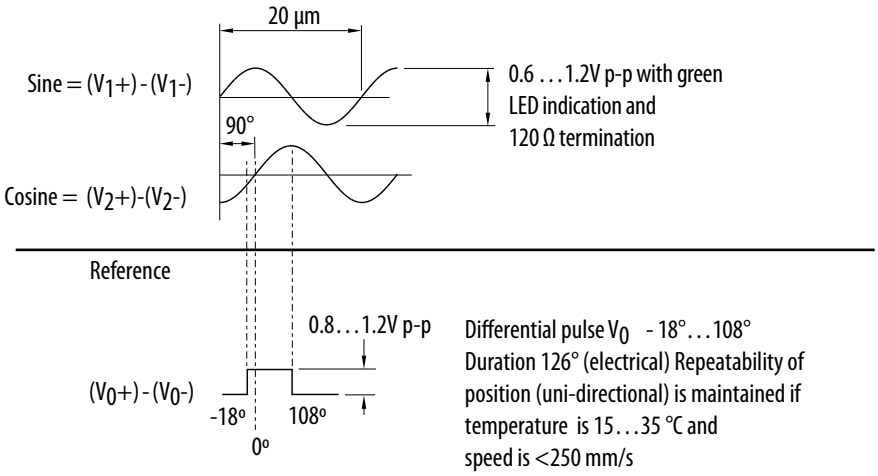
(1) Total termination resistance in ohms.

Sine/Cos Encoder Output Signals

Use the following information to connect a stage with a Sine/Cosine Encoder option to a drive or controller that processes sine/cosine position feedback.

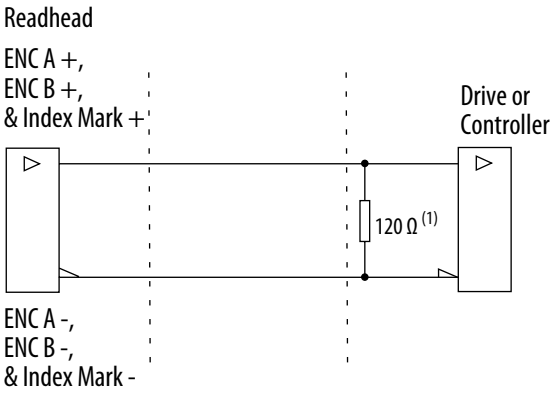
The sine/cos encoder amplitude is 0.90V p-p minimum up to 2 meters per second. 0.60V p-p up to 4 meters per second.

Figure 13 - Sine/Cos Encoder Timing


Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature (90° phase shifted)
20 µm
Sine = $(V_1+)-(V_1-)$
0.6 . . . 1.2V p-p with green LED indication and 120 Ω termination
90°
Cosine = $(V_2+)-(V_2-)$
Reference
0.8. . . 1.2V p-p
Differential pulse V_0 - 18°. . . 108° Duration 126° (electrical) Repeatability of position (uni-directional) is maintained if temperature is 15. . . 35 °C and speed is <250 mm/s
$(V_0+)-(V_0-)$
-18°
108°
0°

Recommended termination = 120 Ω resistors, V0, V1, V2.

Figure 14 - Sine/Cos Encoder Termination

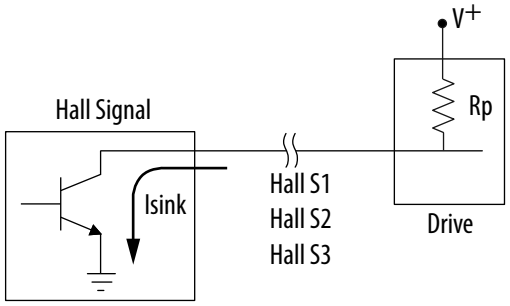


(1) Total termination resistance in ohms.

Hall Effect Circuit

Use the following information to connect the Hall Effect circuit to your servo drive.

- Input power: 5...24 V DC, 10 mA maximum
- Output: NPN, Open Collector, 10 mA maximum



Isink = 10 mA Maximum
Rp = External pull-up resistor

Motor and Hall Phasing and Sequence

Consult drive manual or supplier for wiring instructions for your drive. Motor wiring is phase and commutation sensitive. Motor Phasing Diagram shows the standard phase and sequence relationship of the motor when phased in the positive direction. The Hall signals are used by a compatible three-phase-brushless servo drive to perform electronic commutation. Two types of servo drive Hall-based commutation techniques are possible, Trapezoidal Hall Mode and Encoder Software Mode with Hall startup. For optimal commutation and force generation, the selected servo drive must be compatible with the motor phasing and be wired correctly.

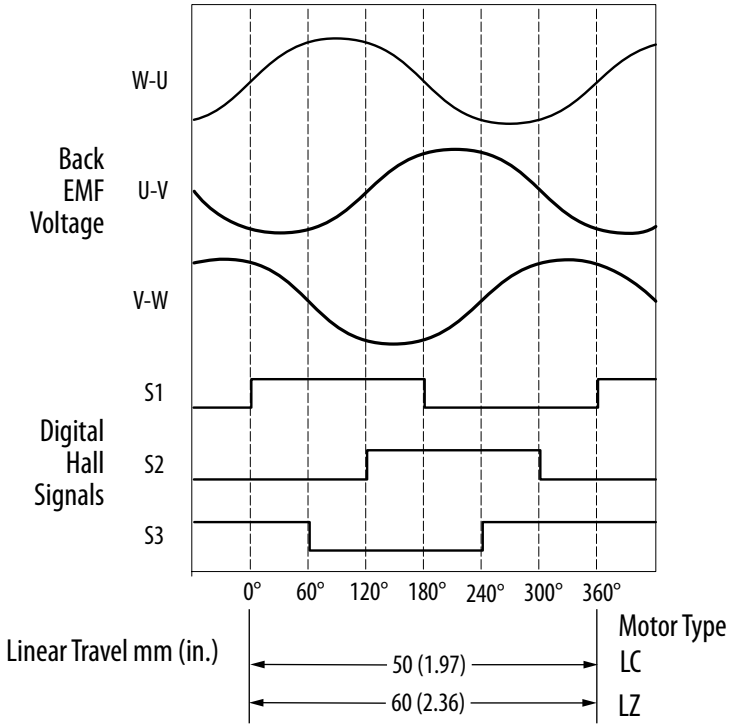
- Observe maximum applied voltage specification.
- Consult drive manual or supplier for drive wiring instructions. Wiring is phase and commutation sensitive.
- Terminate per drive manual instructions.
- Hall Signals, 120° Spacing, Open Collector Transistor 24V maximum.
- Refer to CHPS-Series Stage Connector Data starting on page 33 for termination options, pin, and wire designations.

ATTENTION: Incorrect motor, Hall, or encoder wiring can cause runaway conditions.

As shown in the Motor Phasing Diagram:
S1 in phase with W-U Back EMF
S2 in phase with U-V Back EMF
S3 in phase with V-W Back EMF

Phase sequence = S1 leads S2 leads S3. Spacing is 120°.

Figure 15 - Motor Phasing Diagram
Back EMF Voltage vs. Hall Signals

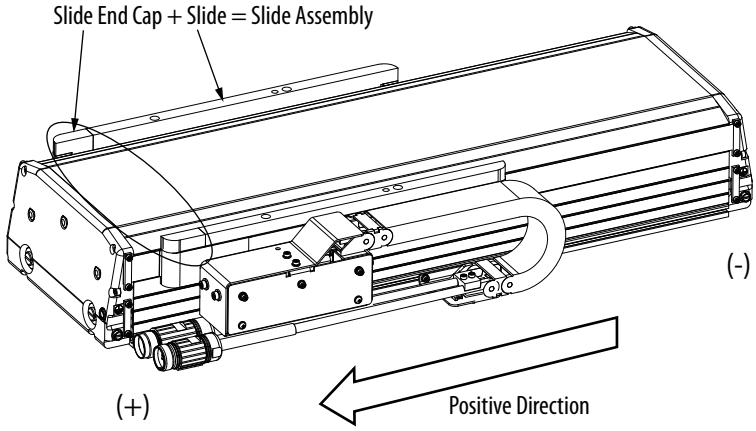


Phasing direction = Slide toward positive end block,

IMPORTANT **Phasing direction = Positive stage direction.**

Stage Positive Direction

Stage positive direction is defined by a location of a Slide End Cap.



Operation Guidelines and Limit Configuration

Introduction

This chapter gives you operational guidelines and limit sensor position adjustment procedures.

Topic	Page
Operational Guidelines	49
Travel Limits	50
Calculating the Stopping Distance	50
Overtravel Limit Sensor Position Adjustment	51
Bumper Stops	53

Operational Guidelines

Please read the following notices about using your stage.

ATTENTION: A runway condition is caused by incorrect motor, Hall, or encoder wiring. It results in uncontrolled speeding of the stage. Keep away from the line of travel while commissioning the stage.

IMPORTANT The customer is responsible for ensuring the servo control system safely controls the stage with regards to maximum force, acceleration, speed, and preventing runaway conditions.

ATTENTION: Stages are capable of very high forces, accelerations and speeds. Moving parts can cause personnel injury. Before running the stage, make sure all components are secure.

Check that the stage travel and air gap is clear of foreign matter and tools.

Objects hit by the moving stage can cause personnel injury or damage to the equipment.

ATTENTION: Do not operate the stage with protective covers removed. Do not go near electrically live parts. High voltages can cause personal injury or death.

Travel Limits

CHPS-Series stages offer three methods for containing slide travel: software travel limits, optional overtravel limit sensors, and standard bumpers stops. For safest operation use all three.

Set software travel limits and overtravel limit sensors according to the maximum speed of the servo drive system and the payload of the application. You can determine the Deceleration Distance between the slide and the end-of-travel bumpers based on the combination of the Deceleration Rate of the load, and the available peak force from the stage-drive. Do a calculation similar to the one in Calculating the Stopping Distance for your application.

Bumper Stop on the stage can stop the slide up to the ratings listed in the table on page 53.

IMPORTANT Bumper stops are not intended as range of motion stops, but they can stop the moving slide up to the ratings listed in Bumper Stops on page 53.

Calculating the Stopping Distance

In the following example we calculate the stopping distance for a 10 kg payload on a CHPS-x8xE-xLMxxxx stage driven by a Kinetix 6000 drive (2094-xxxxx) by using the specification found in Appendix A. Substitute values for your system as necessary.

Known Values:

Slide Moving Mass = 10.32 kg
Payload = 10 kg
Maximum Programmable Velocity(1), Vmax = 2 m/s
Available Peak Force(2) = 600 N @ 23.2 $A_{o\text{-}pk}$

Start with:

$$F = ma \Rightarrow a = \frac{F}{m}$$

Total Moving Mass = m = Payload + Stage Moving Mass
= 10 kg + 10.23 kg = 22.23 kg

$$a = \frac{F}{m} = \frac{600N}{22.23\ kg} = 26.99\ m/s^2$$

So the maximum deceleration rate, Dmax is 26.99 m/s^2.

(1) Velocity and kinetic energy can be much higher due to a uncontrolled worst-case motion constrained by the stroke and power capacity of the motor drive paring only.
(2) Approximation only; actual peak force typically decreases as speed increases.

Calculate the deceleration time, T_d.

$$T_d = \frac{Vmax}{Dmax} = \frac{2\ m/s}{26.99\ m/s^2} = 0.074s$$

Use T_d to calculate the deceleration distance.

$$Distance = \frac{Vmax \times T_d}{2} = \frac{2\ m/s \times 0.074s}{2} = 0.074m = 74\ mm$$

Therefore, you set the software travel limits to 74 mm.

IMPORTANT Velocity and deceleration distance can be much higher due to an uncontrolled worst-case motion constrained by the stroke and power capacity of the motor-drive paring only.

Drive Current Limitation

Your available peak force can be limited by your drive's peak current.

For example a drive with a peak rating of 15 $A_{o\text{-}pk}$ has available peak force 386 N. Here is the calculation:

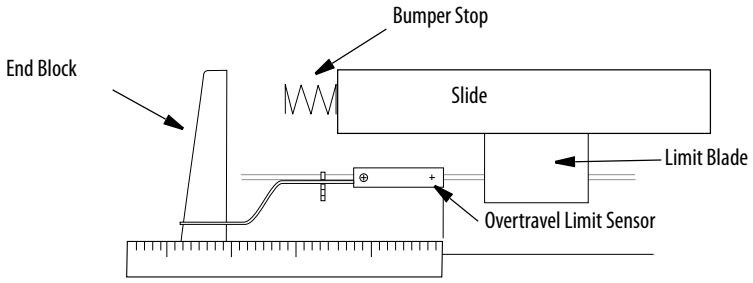
$$Fp = 600N \times \frac{15\ A}{23.3\ A} = 386N$$

Overtravel Limit Sensor Position Adjustment

Maximum stage travel is defined as the distance the slide can travel between end caps such that the bumper stop can touch the end cap but not be compress. You can shorten the slide travel up to 30 mm (1.18 in.) by adjusting the overtravel limit sensor.

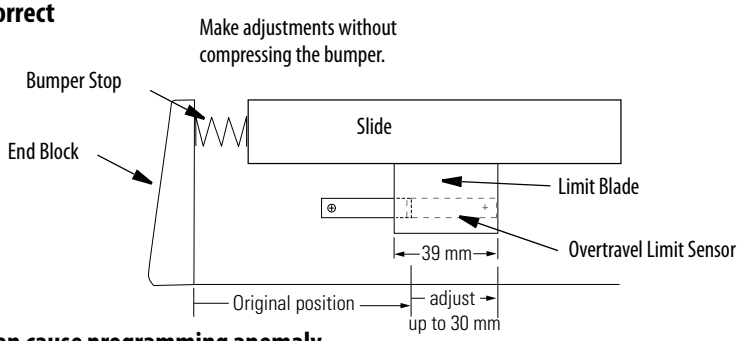
To adjust overtravel limit sensor:

1. Measure location from end block to the inside tip of the overtravel limit sensor.

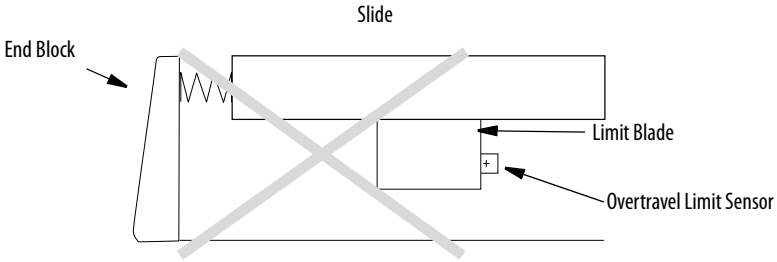


2. Loosen screw and slide the overtravel limit sensor toward center of stage. It can be adjusted up to 30 mm.

Correct



Can cause programming anomaly.



IMPORTANT	Do not adjust the switch more than 30 mm. Doing so can cause a programming anomaly.

3. Redress the limit sensor cables with the cable clips. Make sure wires are neatly against the base and do not interfere with the motion of the limit blade.

Bumper Stops

In addition to software overtravel limits and limit sensors the end of travel bumper stops can stop the slide up to the ratings listed. Bumper stops are not intended to be used as range of motion stops.

Table 4 - Bumper Stop Energy Limits for Stage End of Travel

Cat. No.	Bumper Stop Energy Limit
CHPS-*x6xxxx-x*LM*xxx*	37.3 J (330 in•lb)
CHPS-*x8xxxx-x*LM*xxx*	45.5 J (403 in•lb)
CHPS-*x9xxxx-x*LM*xxx*	35.2 J (312 in•lb)

ATTENTION: If energy greater than the bumper capacity is anticipated in the application, provide additional mechanical means for safely stopping the slide.

To calculate kinetic energy of the slide with your payload use the formula

$$J = \frac{1}{2} \times M \times V^2$$

J in jules
M = moving mass in kg (slide + payload)
V = maximum velocity of stage in your application in m/s(1)

(1) Velocity and kinetic energy can be much higher due to a uncontrolled worst-case motion constrained by the stroke and power capacity of the motor drive pairing only.

Notes:

Troubleshooting

Topic	Page
Before You Begin	55
PTC Thermal Signal	55
Hall Effect Module	55
Hall to Back EMF Phasing	57
Motor Coil Resistance Measurements	58

Before You Begin

The following test equipment is required:

- Ohm meter
- Two-channel storage oscilloscope

PTC Thermal Signal

At ambient room temperature, approximately 25 °C (77 °F), check that the resistance measurement between PTC Temp+ and Common (pins 13 and 14, respectively) on the feedback connector is ≤ 750 Ω.

The table lists increase in resistance at higher temperatures outside the normal operating temperature envelope.

Table 5 - PTC Thermistor Signal Characteristics

Temperature °C (°F)	Resistance in Ohms
Up to 100 (212)	≤ 750
Up to 105 (221)	≤ 7500
Up to 110 (230)	≥ 10,000

Hall Effect Module

Use this procedure to verify the Hall Effect module is operating properly.

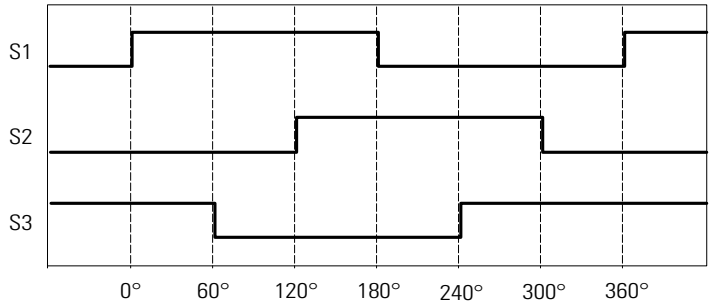
1. With drive power OFF, verify the Hall circuit is properly connected to the drive by using stage and drive interface wiring specifications.
2. Disconnect stage power leads from the drive.
3. Apply power to the Hall device by setting the drive control power to ON.
4. Use an oscilloscope to check waveforms at S1, S2 and S3 at the feedback connector.

Move the slide slowly and steadily by hand in the specified phasing direction to generate the Hall waveform.

5. Check for proper logic levels (approximately 0V = low, V+= high) and correct signal sequence (S1 leads S2, and S2 leads S3) with approximately 120° electrical spacing between signal transitions.

Hall Effect Leads		
Color	**Name**	**Signal Description**
White/Green	S1	Trapezoidal Hall, TTL-Single
Blue	S2	Trapezoidal Hall, TTL-Single
White/Blue	S3	Trapezoidal Hall, TTL-Single

Figure 16 - Hall Signals Waveforms



TIP Connect the common probe from the scope to the Hall signal common.

To determine the location of the signal common, refer to the Stage Power and Feedback Connections beginning on page 40.

6. Before assuming a Hall module fault check Hall field wiring or drive Hall circuit interface.

Hall to Back EMF Phasing

Verify the Hall to Back EMF Phasing with this procedure.

1. With drive power OFF.
2. Verify the Hall circuit is connected to the drive as describe in the CHPS-Series Connector Data beginning on page 33.
3. Disconnect the stage motor power leads from the drive.

EXAMPLE	To observe W-U Back EMF phase polarity, connect oscilloscope probe tip to the W phase and the common probe to the U phase.

4. Apply power to the Hall device by setting the drive control power to ON.
5. Slowly and steadily move the stage by hand to perform the Hall signal test, except this time check the motor phases are in-phase with the Hall signal as shown in the Motor Phasing Schematic on page 58.

   Make sure the phase error between Hall signal and in-phase Back EMF does not exceed ± 5 electrical degrees.
6. If poor results were obtained in step 5 repeat the test at the stage power terminations to check field wiring

ATTENTION: Dangerous voltages, forces and energy levels exist in servo controlled systems. Extreme care must be exercised when operating, maintaining or servicing the stage to prevent harm to personnel or equipment.

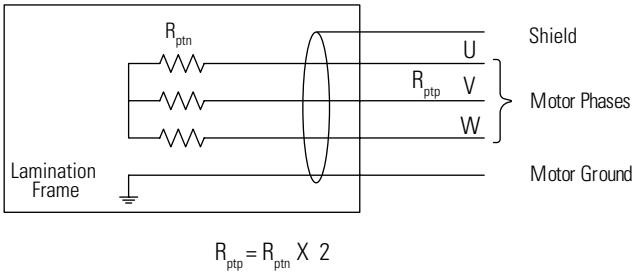
Motor Coil Resistance Measurements

If a motor coil electrical problem is suspected perform this check.

1. Let the coil attain ambient room temperature, approximately 25 °C (77 °F).
2. Verify the drive power is OFF.
3. Disconnect all stage leads (phases and ground) from the drive.
4. Measure the phase-to-phase (ptp) resistance of the phase combinations (U to V, V to W, and W to U) and record the values.

   Verify these three readings are approximately equal to each other.

Figure 17 - Motor Phasing Schematic



   Compare the phase resistance readings to the cold resistance specification of the coil model. See CHPS-Series Stage Technical Specifications on page 83.

   If the three readings are balanced but vary from the specified reading, the reason can be a special coil model. Cable resistance can cause the result to be significantly higher.

5. To rule out the cable resistance, disconnect the stage cable and repeat the procedure this time at the stage motor power termination at the junction box.
6. Measure and verify the phase-to-ground resistance for each phase is >100 MΩ. A lower reading indicates a potential electrical problem.

   To rule out a field cable problem disconnect the stage cable and repeat the procedure this time at stage motor power termination.

   If any reading with the cable disconnected is ≤ 100 MΩ, consult Rockwell Automation; the stage can have an internal electrical problem

IMPORTANT Do not perform coil or insulation electrical stress tests (Megger or Hi-Pot test) without consulting Rockwell Automation technical support.

Maintenance

Topic	Page
Before You Begin	59
Lubricate the Bearing	60
Optical Encoder Scale Maintenance	60
Strip Seal Cleaning	61
Cover Cleaning	61

IMPORTANT Any person that teaches, operates, maintains, or repairs these stages must be trained and demonstrate the competence to safely perform the assigned task.

Before You Begin

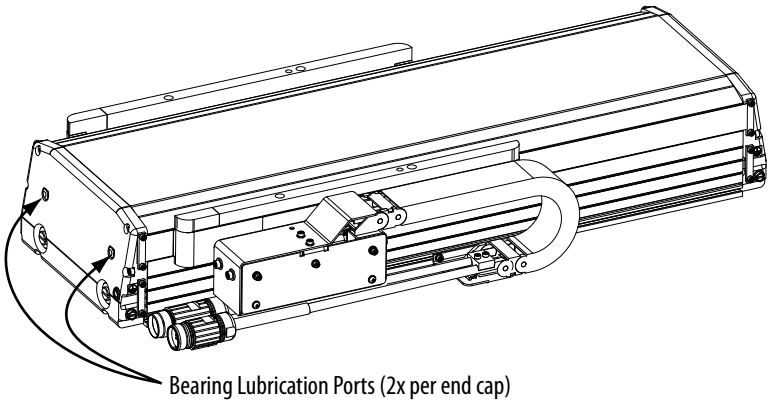
The following tools are required to lubricate and clean your stage.

ATTENTION: Lockout tagout power before servicing.

- 0.5 m (14 in.) or larger clamp with soft jaws.
- Grease (catalog number MPAS-CART).
- Grease gun kit (catalog number MPAS-GPUMP) with tip type installed and primed.
- Air line with maximum pressure of 10 psi.
- Lint free cloth.
- A few drops of isopropyl alcohol if necessary for cleaning encoder scale.

Lubricate the Bearing

Your stage requires lubrication every 6 months or 2500 km (1550 mi) of travel, which ever comes first. Use the MPAS grease gun kit and grease cartridge, catalog numbers MPAS-GPUMP and MPAS-CART respectively.



1. Position slide at end of travel and clamp it to hold the stage against end cap.

ATTENTION: Do not use clamp across the side panels. This can deform and damage the side panels.

2. Remove the lubrication port protective caps.
3. Insert the tip of grease gun in the lubrication port. Push in until contact with bearing grease nipple is felt.
4. Pump handle until back pressure is felt or two strokes are completed.
5. Repeat steps 3 and 4 to the second bearing on this side.
6. Move slide to opposite end of travel and repeat steps 1…5.
7. Remove clamp.
8. Reinstall the protective caps on all the lubrication ports.

Optical Encoder Scale Maintenance

1. If installed remove strip seal and side cover on the side opposite the cable carrier.
2. Clear any coarse or abrasive particles with a clean air line with maximum pressure of 10 psi.
3. Clean scale with a clean dry cloth. Avoid the use of solvents.
4. If necessary use isopropyl alcohol sparingly, apply with a wetted cloth by using a gentle wiping action.
5. Reinstall side cover and strip seal, if used.

Strip Seal Cleaning

Clean the strip seals, if installed, by using a lint free cloth lightly saturated with isopropyl alcohol

IMPORTANT Replace the strip seal if it cannot be cleaned, or if an uneven or scored surface is detected during cleaning.

A buildup of foreign material on the strip seal degrades the performance of the linear stage. This buildup coupled with rapid movement of the slide and the resulting friction can score the surface and create a burnished appearance on the strip seal

Elements contributing to a typical buildup on the strip seals are dust, grease, and other contaminates normally encountered in any operating environment that is not strictly controlled.

Refer to the Strip Seal Removal procedure on page 65 and Strip Seal Replacement procedure on page 66 when performing this task.

Cover Cleaning

Clean the covers at the same time you clean the strip seals. Use pressurized air and a lint free cloth lightly saturated with isopropyl alcohol to remove any dirt or grease.

Notes:

Removing and Replacing Stage Components

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Cable Carrier Module Installation	64
Strip Seal Removal	65
Stage Cover Removal	65
Stage Side Cover Removal	65
Strip Seal Replacement	66
Stage Cover Installation	67
Side Cover Installation	67

Before You Begin

The following tools are required before you begin removal and replacement procedures.

- Torque wrench
- Phillips head screw driver
- 2.5 mm hex wrench
- 3 mm hex wrench
- 4 mm hex wrench
- Fine-point permanent marker
- Tin snips
- Loctite 222

Cable Carrier Module Removal

Use this procedure to remove the cable carrier module assembly.

TIP Mark the location of the end bracket before removing the cable carrier, this makes it easier to align the carrier when re-installing.

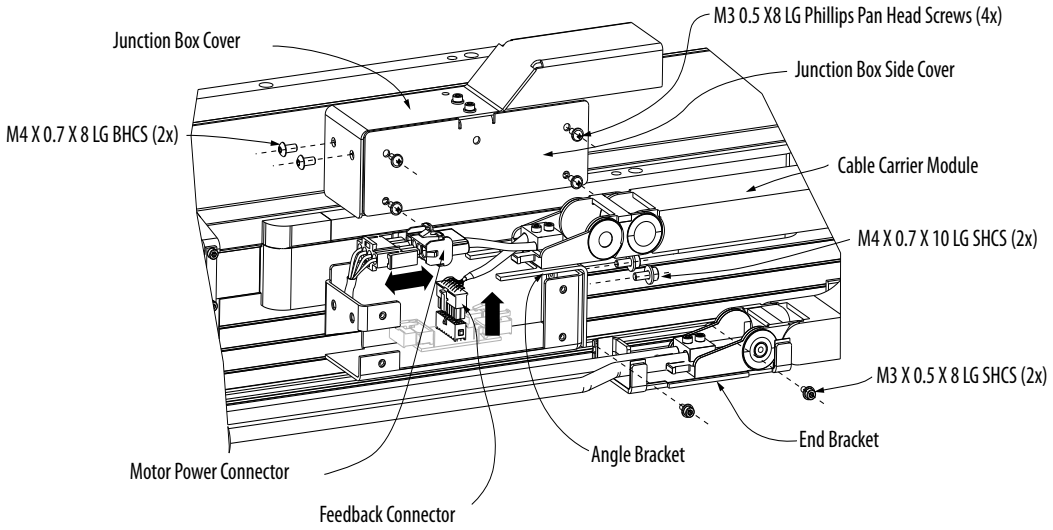
1. Remove the four (4) pan head screws from junction box side cover.
2. Remove the two (2) button head cap screws (BHCS) from the junction box cover.

3. Remove junction box cover assembly.

> **ATTENTION:** Never pull on wires when disconnecting power and feedback connectors. Damage to the connector can occur.

4. Separate motor power connector by squeezing the side tabs and pulling on the housing. Do not pull on the wires

Figure 18 - Cable Carrier Module Replacement


Junction Box Cover
M3 0.5 X8 LG Phillips Pan Head Screws (4x)
Junction Box Side Cover
M4 X 0.7 X 8 LG BHCS (2x)
Cable Carrier Module
M4 X 0.7 X 10 LG SHCS (2x)
M3 X 0.5 X 8 LG SHCS (2x)
End Bracket
Angle Bracket
Motor Power Connector
Feedback Connector

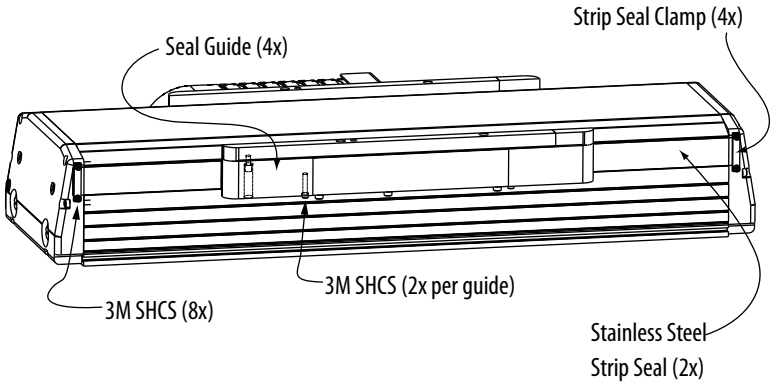
5. Separate the feedback connector from the circuit board by pushing on the center tab and pulling up on the connector housing. Do not pull on wires.
6. Remove the two (2) SHCS from the angle bracket.
7. Lay the cable carrier out flat and mark the location of the end bracket on the base.
8. Loosen but do not remove the two (2) SHCS that secure the end bracket to the stage base.
9. Remove cable carrier.

Cable Carrier Module Installation

Align the cable carrier module with the marks made before removing and follow cable carrier removal procedure in reverse.

Strip Seal Removal

Figure 19 - Stage Seal Components .



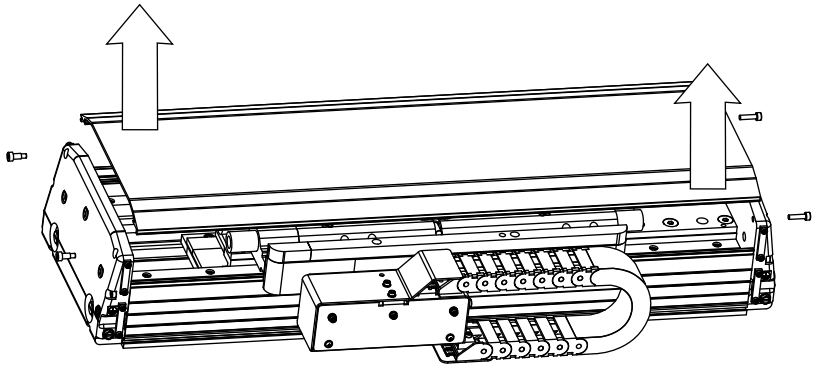
IMPORTANT	Handle strip seal material with care. The strip seal has sharp edges that can cut if mishandled

1. Loosen the strip seal clamps at each end of the stage.
2. Carefully grasp the end of the strip seal and slide it out of the stage.

Stage Cover Removal

1. Remove strip seals following strip seal removal procedure.
2. Remove the (4) M4 screws securing the stage cover to the end caps.
3. Remove cover.

Figure 20 - Cover Removal



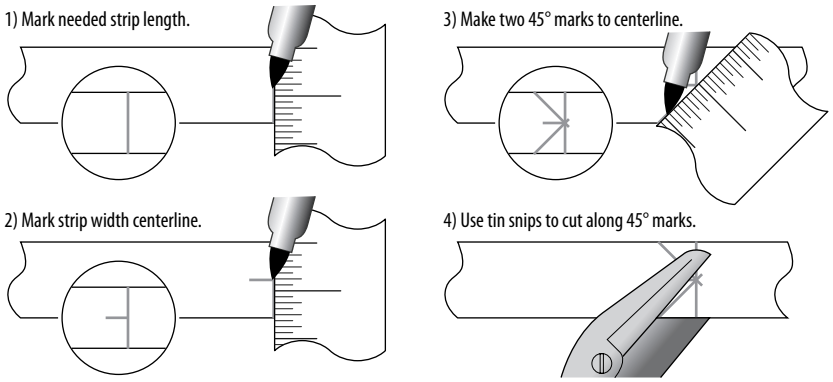
Stage Side Cover Removal

1. Remove strip seals following strip seal removal procedure.
2. Remove the (2) M4 x.07 screws securing the side cover to the end caps.
3. Remove side cover by dropping it down so the lower lip clears the channel.

Strip Seal Replacement

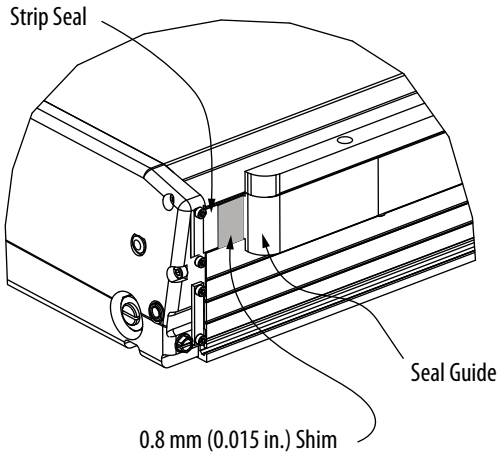
ATTENTION: Handle strip seal material with care. Strip seal has sharp edges that can cause personal injury if mishandled.

1. Remove power from unit and Lockout-Tagout the power source.
2. Follow the instructions below on how to measure, mark, and cut new strip seals.


1) Mark needed strip length.
3) Make two 45° marks to centerline.
2) Mark strip width centerline.
4) Use tin snips to cut along 45° marks.

3. Position slide at middle of travel.
4. Loosen end clamps and screws on one seal guide enough to expose center metal section of guide.
5. Thread new strip seal, point end first, through the seal guides, slide and end clamps.
6. Center and smooth strip seal against top cover and side panel magnetic strips.
7. With very light pressure hold the seal guide against the strip seal and tighten the seal guide.
8. Tighten only one end clamp.
9. Move the slide by hand through travel and make sure the strip seal seats smoothly against the cover and side panel magnet strips. Pulling against the tightened end clamp to help smooth the seal.
10. Once the seal lays flat and smooth against the top cover and side panel, tighten the second end clamp.
11. With the outside edge of the end clamps as a guide, use tin snips to cut and remove excess strip seal material.

12. Position slide at the far ends of travel and re-adjust seal guide by inserting a 0.8 mm (0.015 in.) shim between seal guide and strip seal.



13. Return stage to service.

Stage Cover Installation

1. Starting at the end cap with the magnetic warning label. Install (2) M3 x 25 SHCS and torque to 4 N•m (35 lbf•in). Make sure the cover makes contact with the end cap.
2. On the opposite end install (2) M3 x 30 SHCS and bottom out the screw. The cover does not contact the end cap on this side it floats on the screw.

Side Cover Installation

1. Insert side cover into the stage base by holding it with the top slightly tilted outward and hooking bottom in the channel near bottom of the base.
2. Starting at the end cap with the magnetic warning label or the MP motor. Install (1) M4 x 0.7 x 30 LG SHCS and torque to 4 N•m (35 lb•in). Make sure the side cover makes contact with the end cap.
3. On the opposite end install (1) M4 x 0.7 x 30 LG SHCS and torque 2.26 N•m (20 lb•in). The side cover does not contact the end cap on this side.

Notes:

Specifications and Dimensions

This appendix is a supplement to this document. Associated Kinetix publications listed in Additional Resources on page 9 and information in product specifications can supersede the information in this appendix.

Topic	Page
Static and Static Moment Loads	70
Performance Specifications for 325V CHPS-Series Stage	70
Performance Specifications for 325V or 650V CHPS-Series Stage	71
Accuracy Specification for the CHPS-Series Stage	73
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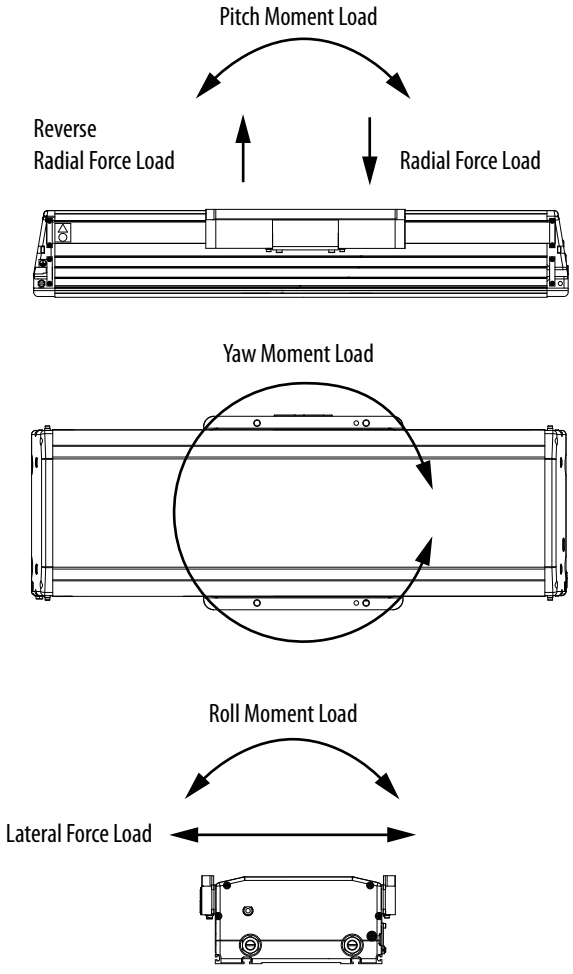
Static and Static Moment Loads

The figure depicts the Static and Static Moment Loads in the tables that follow.

Table 6 - Static and Static Moment Loads on Linear Stages



The static moment and force ratings shown in the tables are the maximum permissible values possible before permanent damage to the linear stage can occur. To determine the estimated L10 bearing and ball screw life of CHPS-Series Integrated Linear Stages, use Motion Analyzer software version 4.4 or later.

Performance Specifications for 325V CHPS-Series Stage

Maximum cable length 10 m (33 ft). Please contact Applications Engineering concerning application requiring longer cables.

Table 7 - Performance Specifications for 150 mm frame size CHPS-Series Linear Stages

Cat. No.	Slide Mass	Continuous (1) (2)		Peak		Maximum Static Load(3)	Max Static Moment Loads(3)		
		Current	Thrust	Current	Thrust		Pitch	Yaw	Roll
	kg (lb)	A rms (Ao-pk)	N (lbf)	A rms (Ao-pk)	N (lbf)	kN (lbf)	kN (lbf)	N•m (ft•lb)	N•m (ft•lb)
CHPS-A6xxxA-xLMxxx	4.64 (10.23)	2.3 (3.3)	80 (18)	7.0 (9.9)	239 (54)	38.0 (8722)	71 (52)	183 (134)	97 (71)
CHPS-A6xxxB-xLMxxx	6.48 (14.28)	4.7 (6.6)	160 (36)	14.0 (19.9)	479 (108)	38.0 (8722)	128 (94)	327 (241)	97 (71)
CHPS-A6xxxC-xLMxxx	6.48 (14.28)	2.3 (3.3)	160 (36)	7.0 (9.9)	479 (108)	38.0 (8722)	128 (94)	327 (241)	97 (71)

(1) Measured at 20 °C (68 °F) ambient.
(2) For covered and sealed stages derate by 10%
(3) Values apply to bearing rating only. Contact Applications Engineering for structural considerations.

Table 8 - Performance Specifications for 200 mm frame size CHPS-Series Linear Stages

Cat. No.	Slide Mass	Continuous(1) (2)		Peak		Maximum Static Load(3)	Max Static Moment Loads(3)		
		Current	Thrust	Current	Thrust		Pitch	Yaw	Roll
	kg (lb)	A rms (Ao-pk)	N (lbf)	A rms (Ao-pk)	N (lbf)	kN (lb)	kN (lbf)	N•m (ft•lb)	N•m (ft•lb)
CHPS-A8xxxA-xLMxxx	4.59 (10.1)	2.1 (3.0)	72 (16)	6.3 (8.9)	215 (48)	66 (14836)	171 9126)	412 (304)	270 (199)
CHPS-A8xxxB-xLMxxx	6.58 (14.5)	4.2 (6.0)	144 (32)	12.6 (17.9)	431 (97)	66 (14836)	270 (199)	620 (457)	270 (199)
CHPS-A8xxxC-xLMxxx	6.58 (14.5)	2.1 (3.0)	144 (32)	6.3 (8.9)	431 (97)	66 (14836)	270 (199)	620 (457)	270 (199)

(1) Measured at 20 °C (68 °F) ambient.
(2) For covered and sealed stages derate by 10%.
(3) Values apply to bearing rating only, Contact Applications Engineering for structural considerations.

Performance Specifications for 250 mm frame size CHPS-Series Linear Stages

Cat. No.	Slide Mass	Continuous (1)(2)		Peak		Maximum Static Load(3)	Max Static Moment Loads(3)		
		Current	Thrust	Current	Thrust		Pitch	Yaw	Roll
	kg (lb)	A rms (Ao-pk)	N (lbf)	A rms (Ao-pk)	N (lbf)	kN (lbf)	kN (lbf)	N•m (ft•lb)	N•m (ft•lb)
CHPS-A9xxxG-xLMxxx	8.58 (18.9)	1.9 (2.7)	109 (25)	5.8 (8.2)	328 (74)	93.6 (21042)	170 (125)	385 (283)	508 (375)
CHPS-A9xxxH-xLMxxx	9.62 (21.2)	3.8 (5.4)	219 (49)	11.5 (16.3)	656 (147)	93.6 (21042)	324 (239)	734 (541)	508 (375)
CHPS-A9xxxI-xLMxxx	9.62 (21.2)	1.9 (2.7)	219 (49)	5.8 (8.2)	656 (147)	93.6 (21042)	324 (541)	734 (541)	508 (375)

(1) Measured at 20 °C (68 °F) ambient.
(2) For covered and sealed stages derate by 10%.
(3) Values apply to bearing rating only. Contact Applications Engineering for structural considerations.

Performance Specifications for 325V or 650V CHPS-Series Stage

Maximum cable length 10 m (33 ft). Please contact Applications Engineering concerning application requiring longer cables.

Table 9 - Performance Specifications for 200 mm frame size CHPS-Series Linear Stages

Cat. No.	Slide Mass	Continuous [1][2]		Peak		Maximum Static Load[3]	Max Static Moment Loads[3]		
		Current	Thrust	Current	Thrust		Pitch	Yaw	Roll
	kg (lb)	A rms (Ao-pk)	N (lbf)	A rms (Ao-pk)	N (lbf)	kN (lbf)	kN (lbf)	N•m (ft•lb)	N•m (ft•lb)
CHPS-x8xxxD-xLMxxx	5.64 (12.4)	3.1 (4.3)	132 (30)	8.3 (11.7)	302 (68)	66 (14836)	171 9126)	412 (304)	270 (199)
CHPS-x8xxxE-xLMxxx	8.34 (18.4)	6.2 (8.7)	265 (60)	16.5 (23.3)	600 (135)	66 (14836)	270 (199)	620 (457)	270 (199)
CHPS-x8xxxF-xLMxxx	8.34 (18.4)	3.1 (4.3)	265 (60)	8.2 (11.6)	600 (135)	66 (14836)	270 (199)	620 (457)	270 (199)

(1) Measured at 20 °C (68 °F) ambient.
(2) For covered and sealed stages derate by 10%.
(3) Values apply to bearing rating only. Contact Applications Engineering for structural considerations.

Performance Specifications for 250 mm frame size CHPS-Series Linear Stages

Cat. No.	Slide Mass	Continuous [1][2]		Peak		Maximum Static Load[3]	Max Static Moment Loads[3]		
		Current	Thrust	Current	Thrust		Pitch	Yaw	Roll
	kg (lb)	A rms (Ao-pk)	N (lbf)	A rms (Ao-pk)	N (lbf)	kN (lbf)	kN (lbf)	N•m (ft•lb)	N•m (ft•lb)
CHPS-x9xxxJ-xLMxxx	11.54 (25.4)	3.0 (4.2)	385 (87)	8.1 (11.5)	882 (198)	93.6 (21042)	170 (125)	385 (283)	508 (375)
CHPS-x9xxxK-xLMxxx	9.69 (21.4)	3.0 (4.2)	193 (43)	8.1 (11.5)	441 (99)	93.6 (21042)	324 (239)	734 (541)	508 (375)
CHPS-x9xxxL-xLMxxx	11.54 (25.4)	6.0 (8.5)	385 (87)	16.2 (22.9)	882 (198)	93.6 (21042)	324 (541)	734 (541)	508 (375)

(1) Measured at 20 °C (68 °F) ambient.
(2) For covered and sealed stages derate by 10%.
(3) Values apply to bearing rating only. Contact Applications Engineering for structural considerations.

General Stage Specifications

The following sections contain general specifications.

Accuracy Specification for the CHPS-Series Stage

Cat. No	Repeatability µm (in.)	Accuracy[1][2][3] µm (in.)	Straightness and Flatness[3] µm (in.)
CHPS-xxxxxx-FLMxxx	±1.0	±3 µm/25 mm NTE ±10 µm/300 mm (±0.0001 in./1 in. NTE ±0.0004 in./12 in.)	±3 µm/25 mm NTE ±8 µm/300 mm (±0.0001 in./1 in. NTE ±0.0003 in./12 in.)
CHPS-xxxxxx-GLMxxx	±1.5		
CHPS-xxxxxx-HLMxxx	±2.0		
CHPS-xxxxxx-ILMxxx	Interpolation Dependent		

(1) Non-cumulative. For higher performance or software error mapping, please contact Applications Engineering.
(2) Accuracy specification is based upon a 5 kg test load, measured 35 mm above the center of the slide, fully supported on a granite surface.
(3) Based upon a fully supported and clamped in place unit, mounted on a rigid surface with flatness of 0.012/300 x 300 mm, NTE 0.025 mm overall (0.0004/12 x 12 in., NTE 0.001 in. overall)

Commutation Sensor

Description	Specifications
Input Power	5…24V DC, 10 mA max.
Output	NPN, open collector, 10 mA max.

Limit Sensor Specification

Description	Specifications
Input Power	12…28V DC, 15 mA max.
Output	PNP, open collector, normally closed 50 mA max.sourcing

PTC Thermistor Specifications

Temp °C (°F)	Resistance (Ohm)
Up To 100 (212)	Less than 750
Up To 105 (221)	Less than 7500
Up To 110 (230)	Greater than 10,000

Encoder Specifications

Type	Signal	Specification
	Power Supply	5V DC ±5%
Digital	A/B/Index	RS422 Differential Line Driver
Analog	Sine/Cosine	0.6…1.2V p-p Differential Analog
	Integral Index Mark	Differential Pulse 0.8…1.3V p-p

IMPORTANT Contact Application Engineering for third party drives and controllers. The controls need to meet a minimum recommended counter clock frequency that varies with encoder type and resolution and required peak speed.

Maximum Velocity for Allen-Bradley Drives

Table 10 - Maximum Velocity for 150 mm frame size CHPS-Series Linear Stages with Allen-Bradley Drives

Incremental Encoder Option			Maximum Velocity			
Digital Resolution	**Sine/Cosine Period**	**Velocity, max**	**Ultra™ 3000 and Ultra5000 Drives**	**Kinetix 2000 and Kinetix 6500 Drives**	**Kinetix 6000 Drive**	**Kinetix 300 Drive**
µm/count	µm	m/s	m/s	m/s	m/s	m/s
1	—	5.0	4.0	4.0	1.5	2.0
0.5	—	3.0	2.0	2.0	0.7	—
0.1	—	0.7	0.5	—	—	—
—	20	4.0	2.0	2.0	2.0	—

Table 11 - Maximum Velocity for 200 and 250 mm frame size CHPS-Series Linear Stages with Allen-Bradley Drives

Incremental Encoder Option			Maximum Velocity			
Digital Resolution	**Sine/Cosine Period**	**Velocity, max**	**Ulta3000 and Ultra5000 Drives**	**Kinetix 2000 and Kinetix 6500 Drives**	**Kinetix 6000 Drive**	**Kinetix 300 Drive**
µm/count	µm	m/s	m/s	m/s	m/s	m/s
1	—	5.0	4.0	4.0	1.5	2.0
0.5	—	3.0	2.0	2.0	0.7	—
0.1	—	0.7	0.5	0.5(1)	—	—
—	20	4.0	2.0	2.0	2.0	—

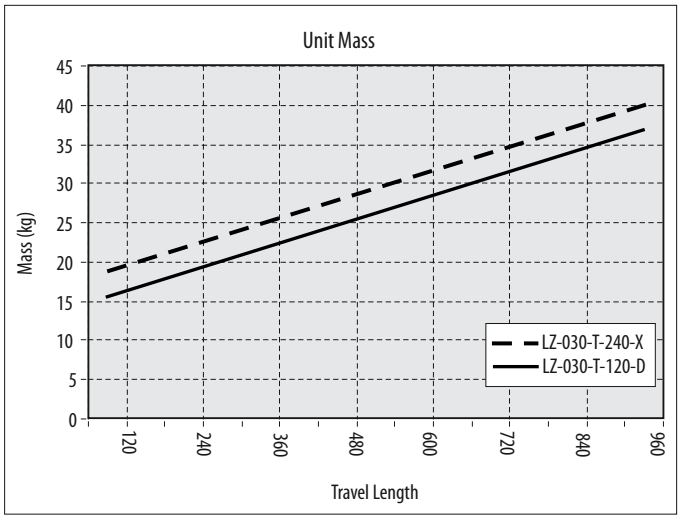
(1) LC motor option only.

Environmental Specifications for CHPS-Series Stages

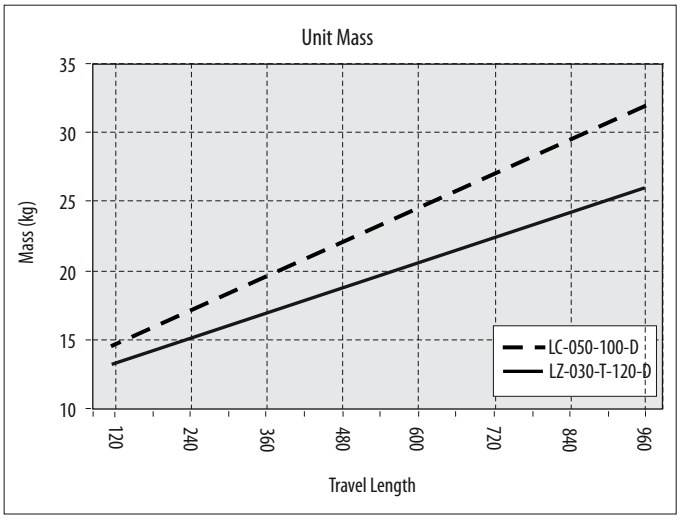
Attribute	Value
Ambient temperature	0...40 °C (32...104 °F)
Storage temperature	-30...70 °C (-22...158 °F)
Relative humidity	5…95% non-condensing
Shock	20 g peak, 6 ms duration
Vibration	0.1 grms @ Hz, 30…2000 Hz
Cable carrier lifetime	10,000,000 cycles

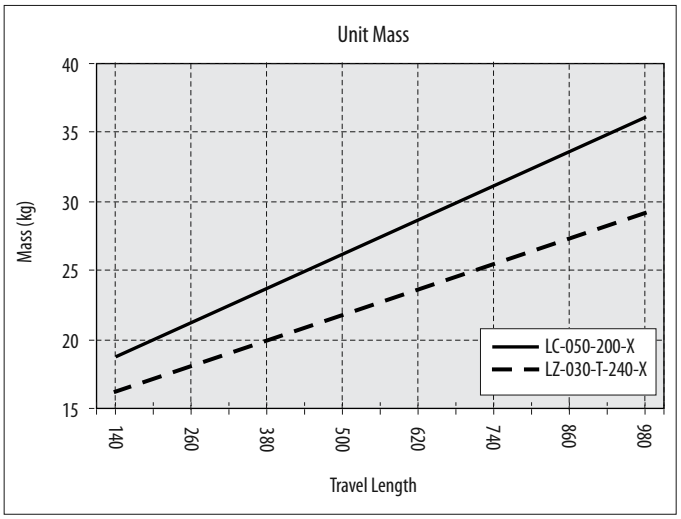
CHPS-Series Stage Travel versus Weight Specifications

CHPS-Series Stage (150 mm frame size)

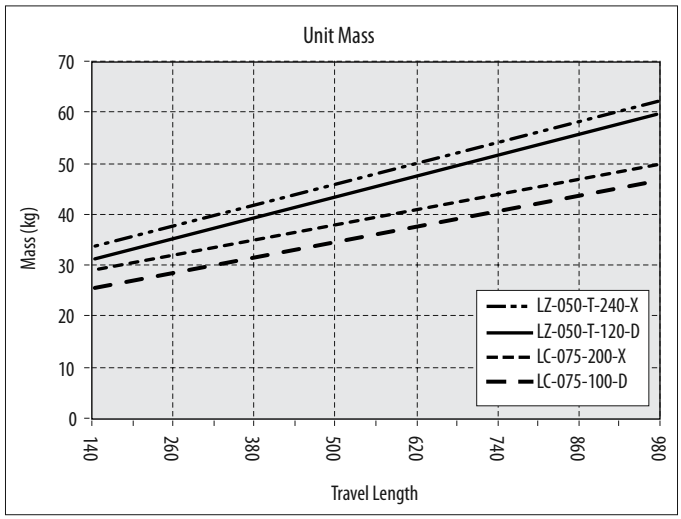


CHPS-Series Stage (200 mm frame size)





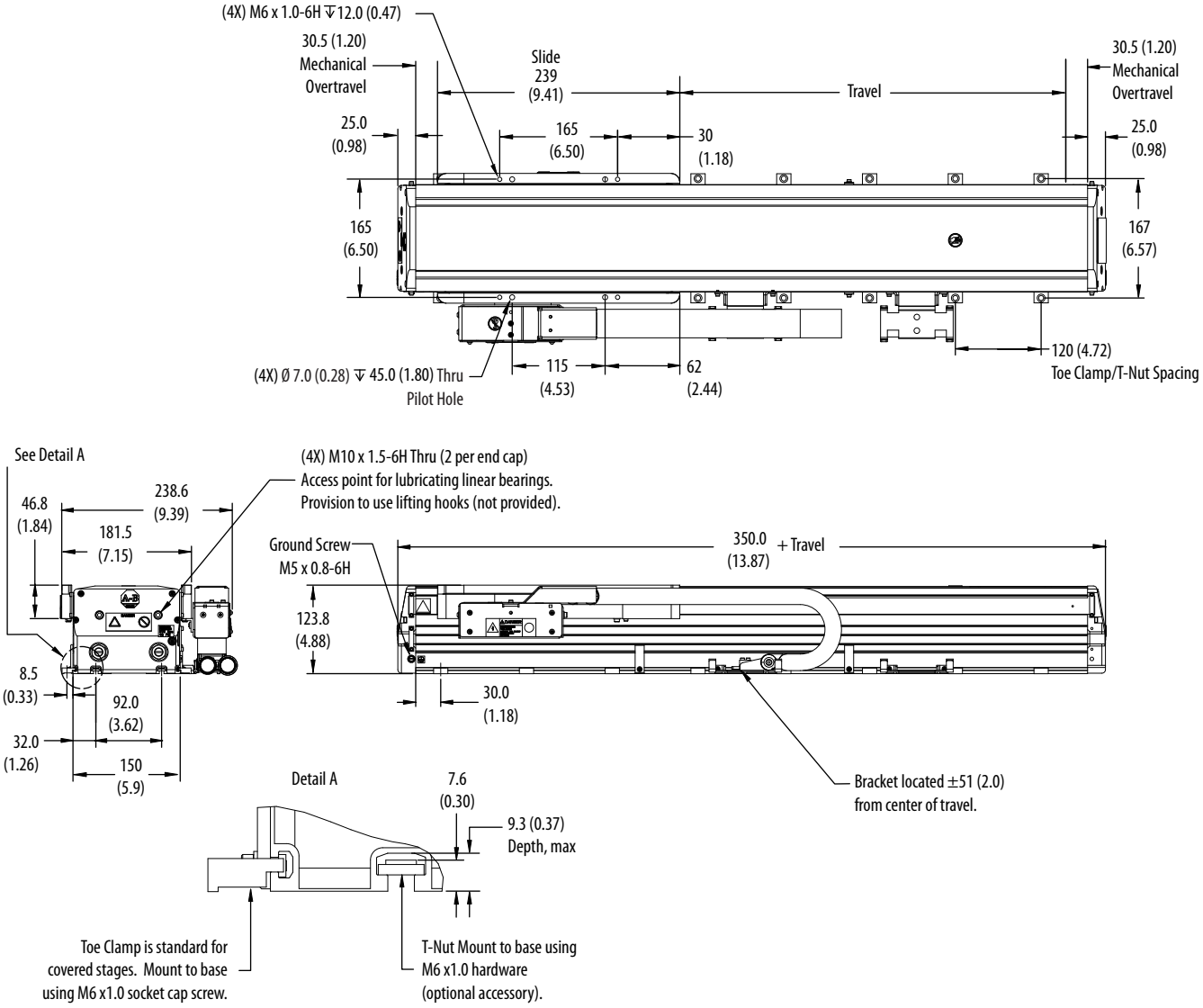
CHPS-Series Stage (250 mm frame size)



CHPS-Series Stage Dimensions

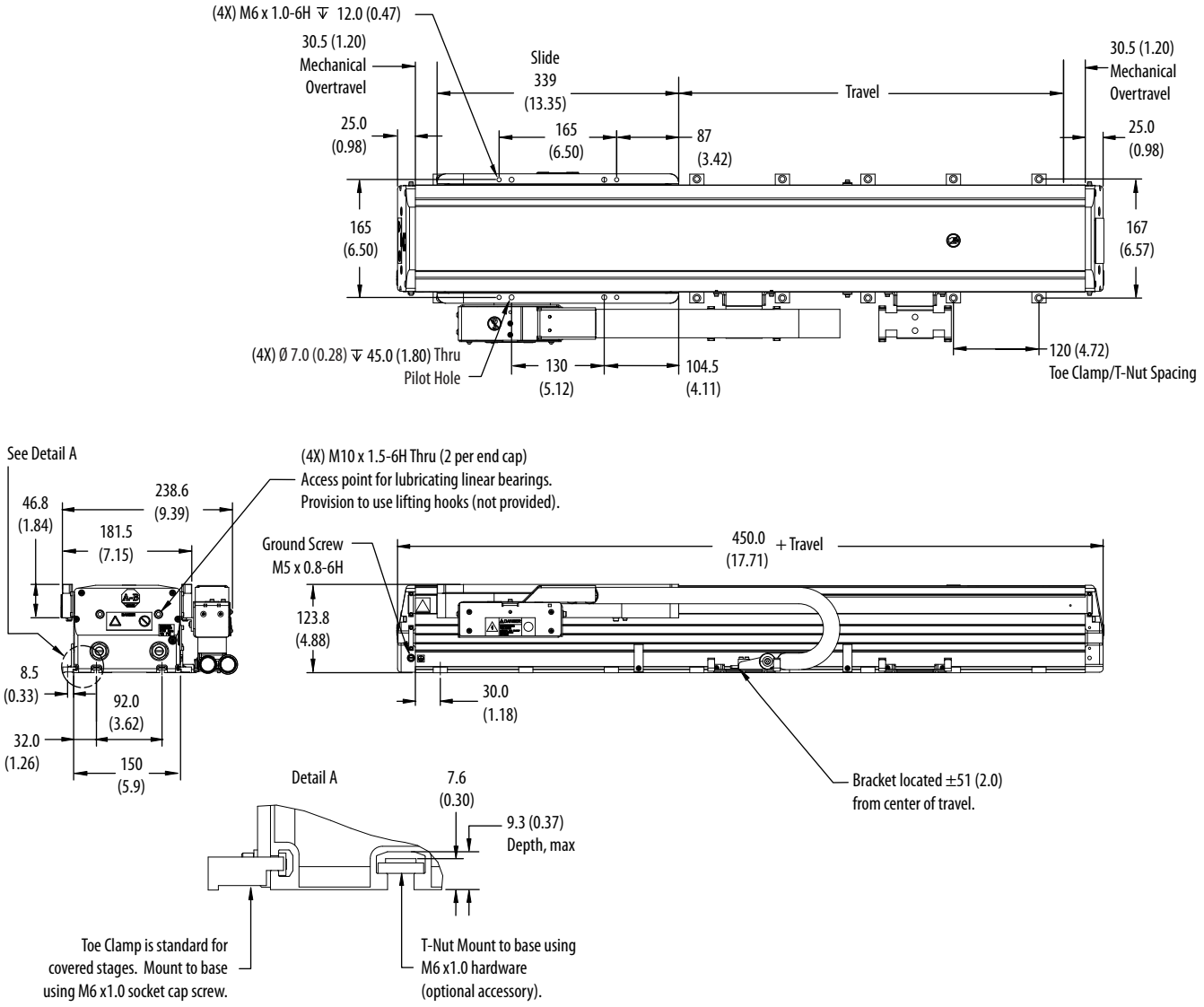
Stage are designed to metric dimensions. Inch dimensions are conversions from millimeters. Dimensions without tolerances are for reference.

Figure 21 - CHPS-A6xxxA-xLMxxx



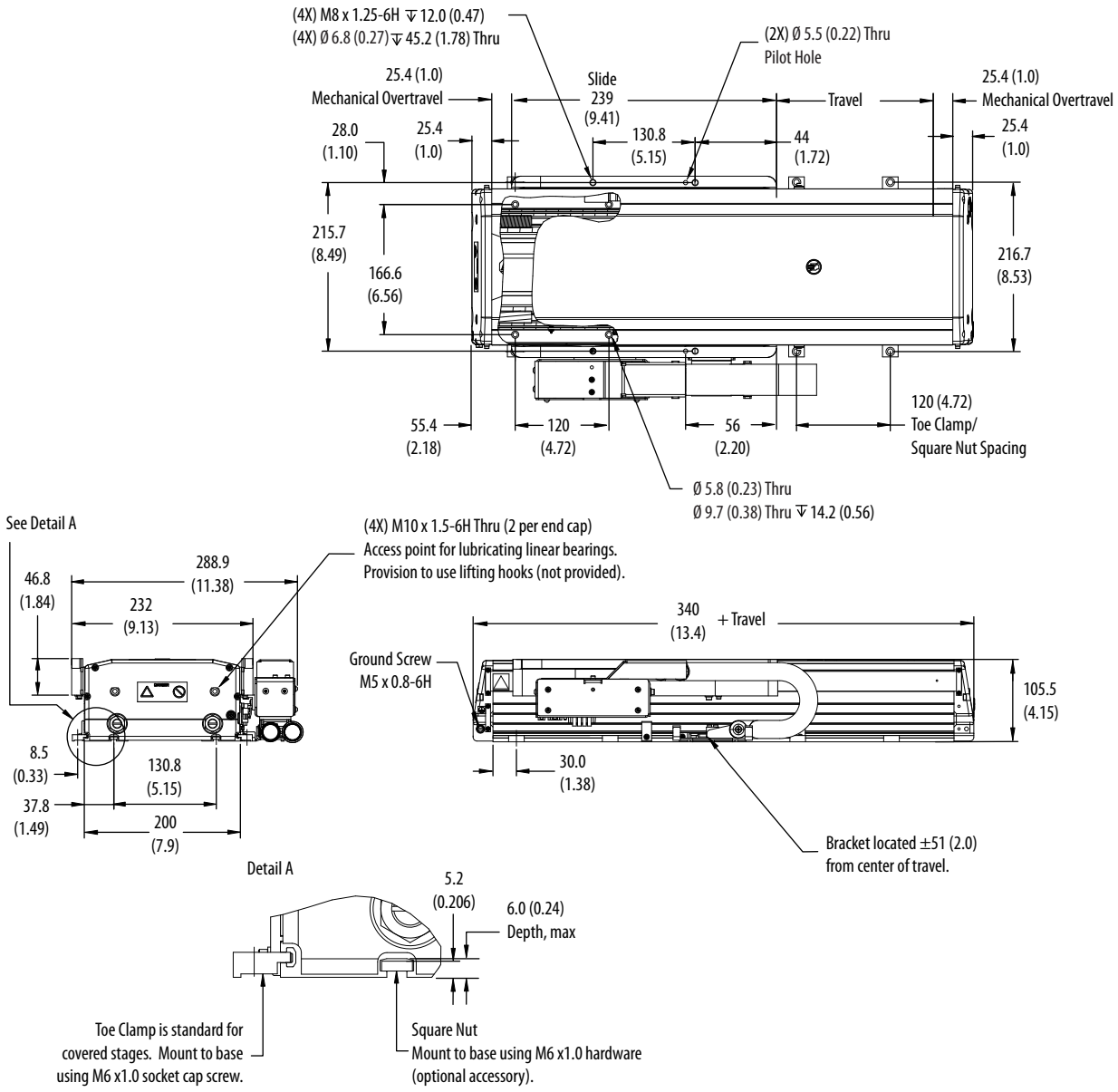
Travel	Length mm (in.)
Shortest	60 (2.36)
Increments	60 (2.36)
Longest	1620 (63.78)

Figure 22 - CHPS-A6xxxB/C-xLMxxx



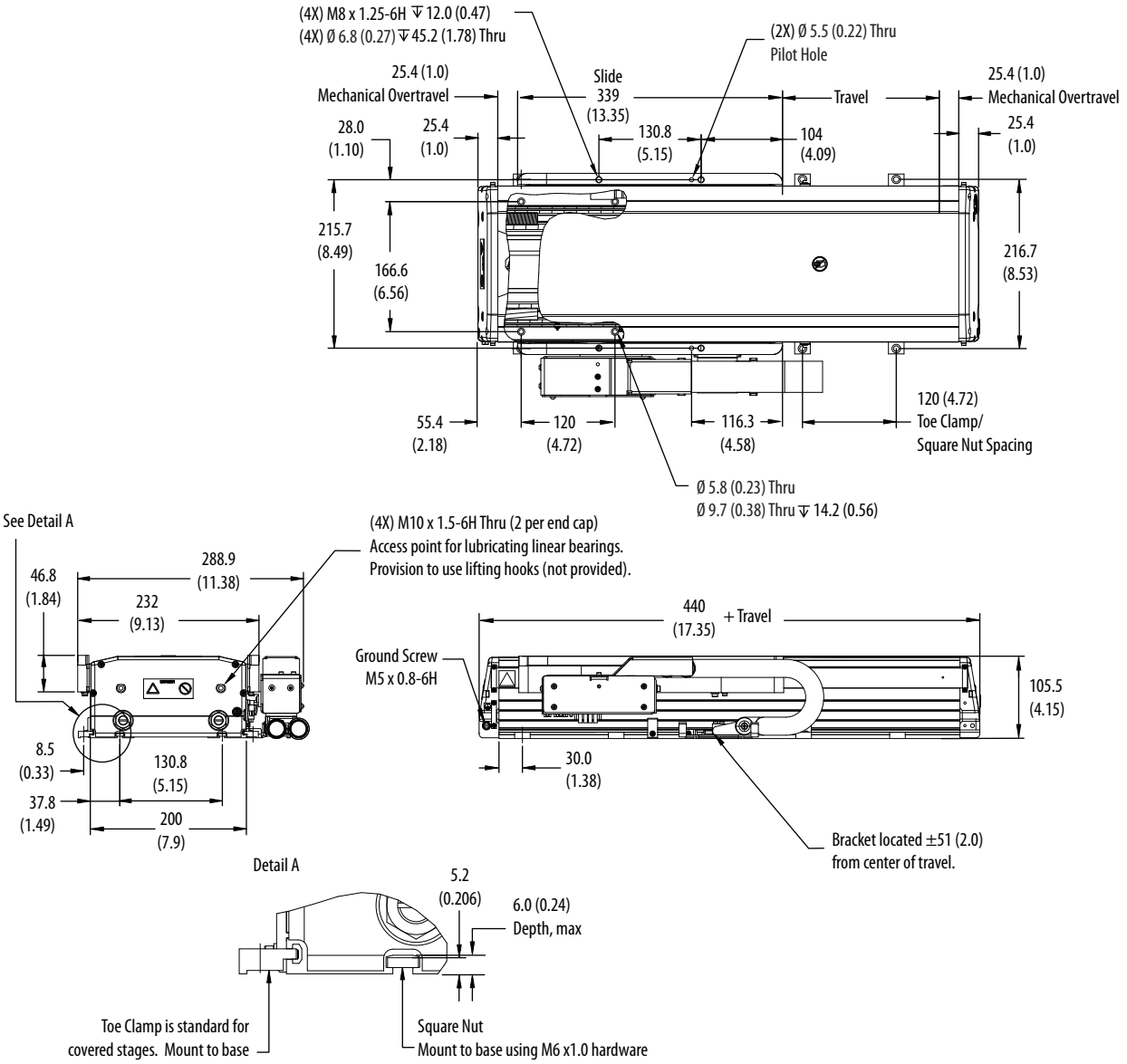
Travel	Length mm (in.)
Shortest	60 (2.36)
Increments	60 (2.36)
Longest	1560 (61.42)

Figure 23 - CHPS-x8xxxA/D-xLMxxx



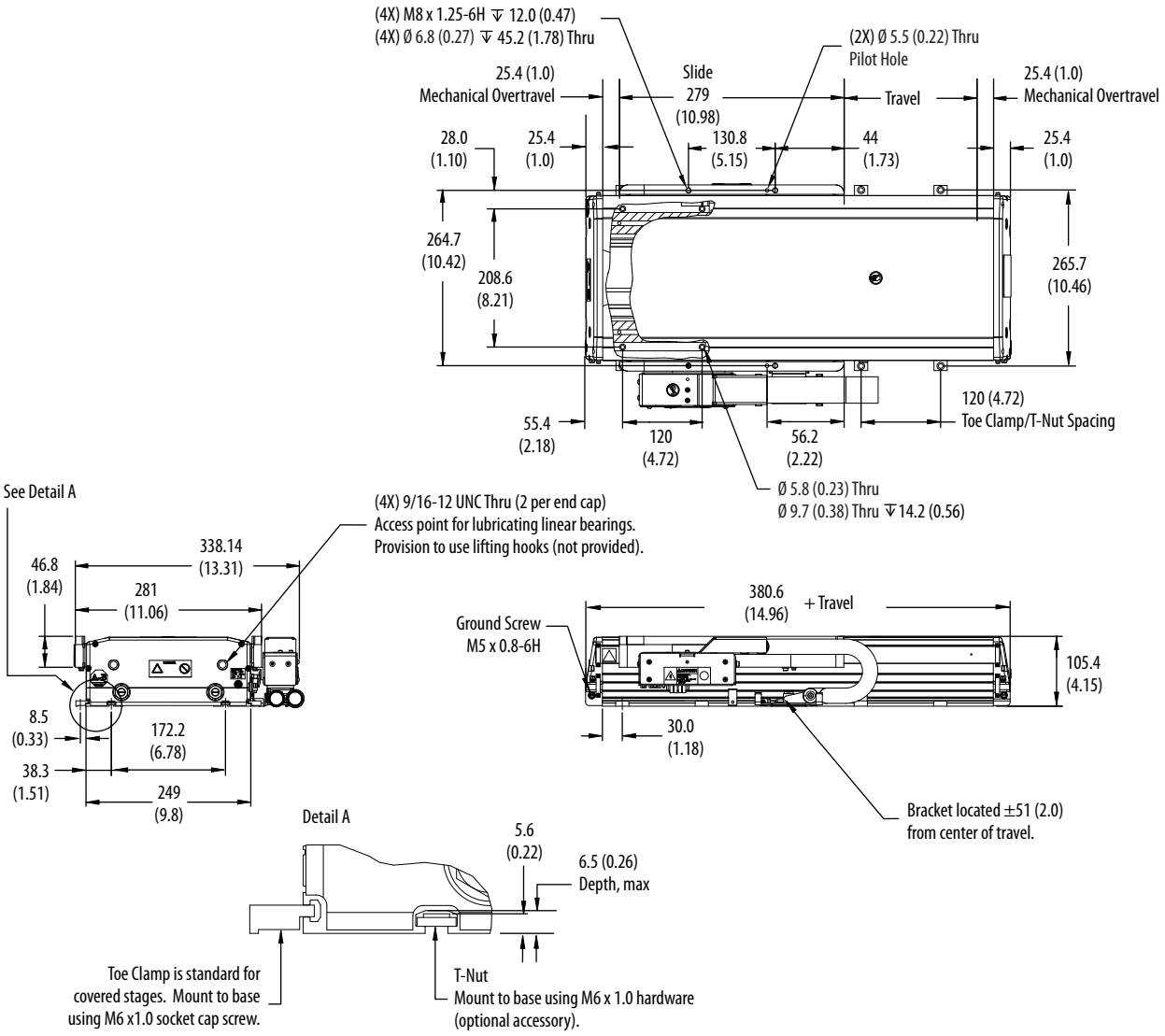
Travel	Length mm (in.)
Shortest	60 (2.36)
Increments	60 (2.36)
Longest	1680 (66.14)

CHPS-x8xxxB/C/E/F-xLMxxx



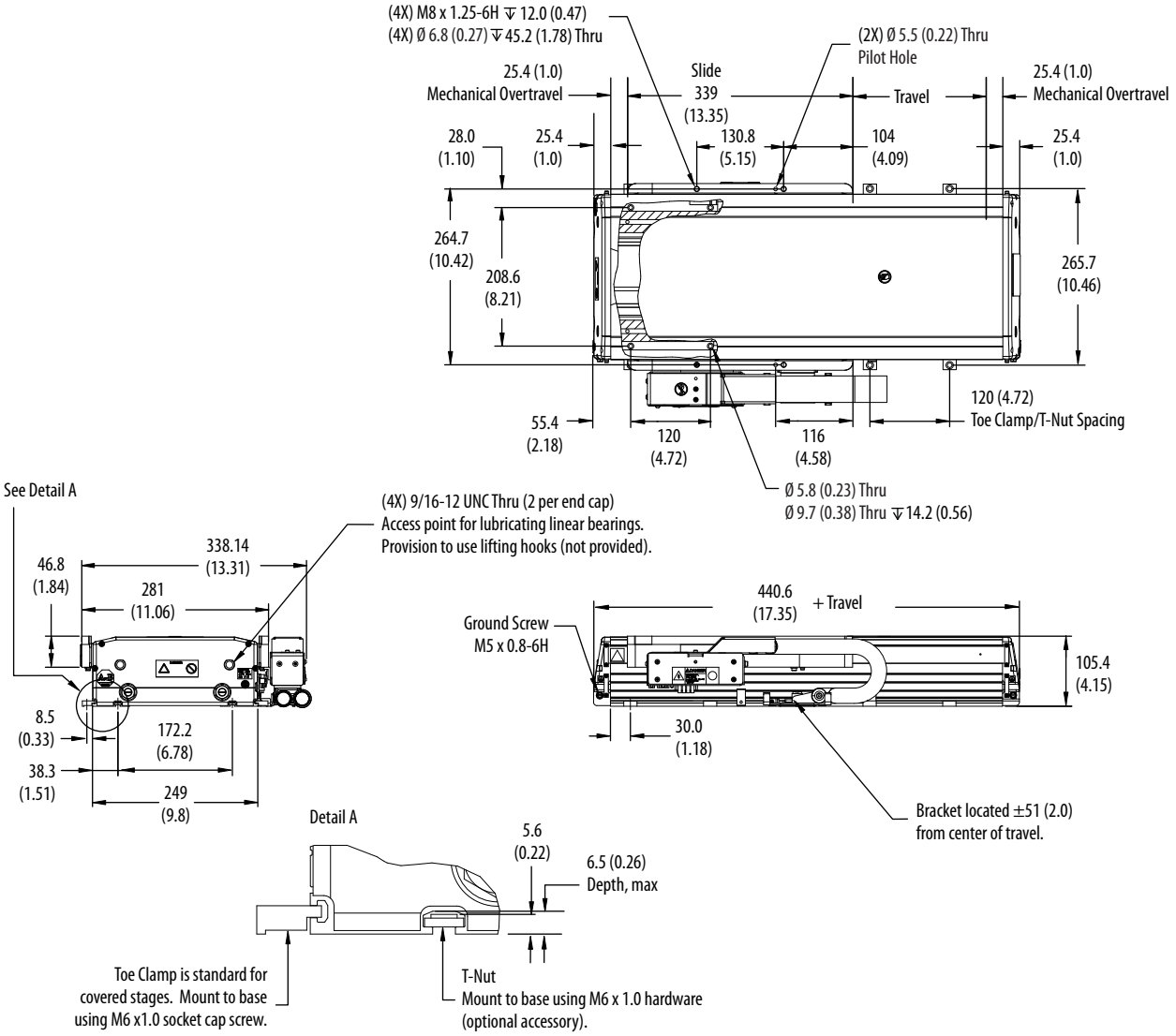
Travel	Length mm (in.)
Shortest	80 (3.15)
Increments	60 (2.36)
Longest	1580 (62.2)

Figure 24 - CHPS-x9xxxG/J-xLMxxx



Travel	Length mm (in.)
Shortest	80 (3.15)
Increments	60 (2.36)
Longest	1640 (64.6)

Figure 25 - CHPS-x9xxxH/I/K/L-xLMxxx



Travel	Length mm (in.)
Shortest	80 (3.15)
Increments	60 (2.36)
Longest	1580 (62.2)

CHPS-Series Stage Technical Specifications

Use this specification to make stage dependent calculations.

Cat. No.	Total Moving Mass	Coil Resistance (p - p)		Force Constant
		@25 °C (77 °F)	@100 °C (212 °F)	
	kg (lb)	Ohms	Ohms	$N/A_{0\text{ - peak}}$ ($lbf/A_{0\text{ - peak}}$)
CHPS-A6xxxA-xLMxxx	5.39 (11.85)	7.2	9.3	24.1 (5.42)
CHPS-A6xxxB-xLMxxx	7.09 (15.6)	3.6	4.6	24.1 (5.42)
CHPS-A6xxxC-xLMxxx	7.09 (15.6)	14.3	18.6	48.2 (10.83)
CHPS-A8xxxA-xLMxxx	6.70 (14.73)	7.2	9.3	24.1 (5.42)
CHPS-A8xxxB-xLMxxx	8.87 (19.52)	3.6	4.6	24.1 (5.42)
CHPS-A8xxxC-xLMxxx	8.87 (19.52)	14.3	18.6	48.2 (10.83)
CHPS-x8xxxD-xLMxxx	7.57 (16.65)	3.8	4.9	30.3 (6.81)
CHPS-x8xxxE-xLMxxx	10.23 (22.5)	1.9	2.4	30.3 (6.81)
CHPS-x8xxxF-xLMxxx	10.23 (22.5)	7.5	9.8	60.7 (13.64)
CHPS-A9xxxG-xLMxxx	8.56 (18.84)	9.4	12.2	40.2 (9.04)
CHPS-A9xxxH-xLMxxx	10.70 (23.53)	4.7	6.1	40.2 (9.04)
CHPS-A9xxxI-xLMxxx	10.70 (23.53)	18.8	24.5	80.4 (18.07)
CHPS-x9xxxJ-xLMxxx	10.02 (22.04)	4.9	6.4	45.5 (10.29)
CHPS-x9xxxK-xLMxxx	13.16 (28.95)	2.5	3.2	45.5 (10.29)
CHPS-x9xxxL-xLMxxx	13.16 (28.95)	9.9	12.8	91.0 (20.46)

Notes:

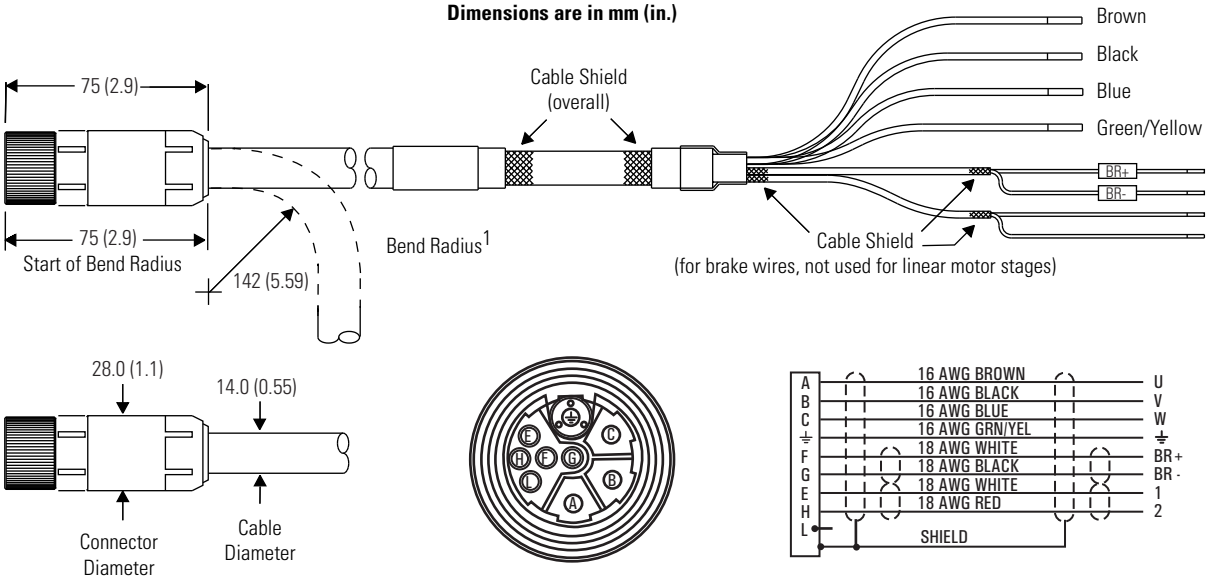
Accessories

Topic	Page
Interconnect Cables	85
Installation, Maintenance, and Replacement Kits	87

Interconnect Cables

Power Cable Dimensions (catalog number 2090-XXNPMF-*16*Sxx)

The maximum cable length of 10 m (32.8 ft).



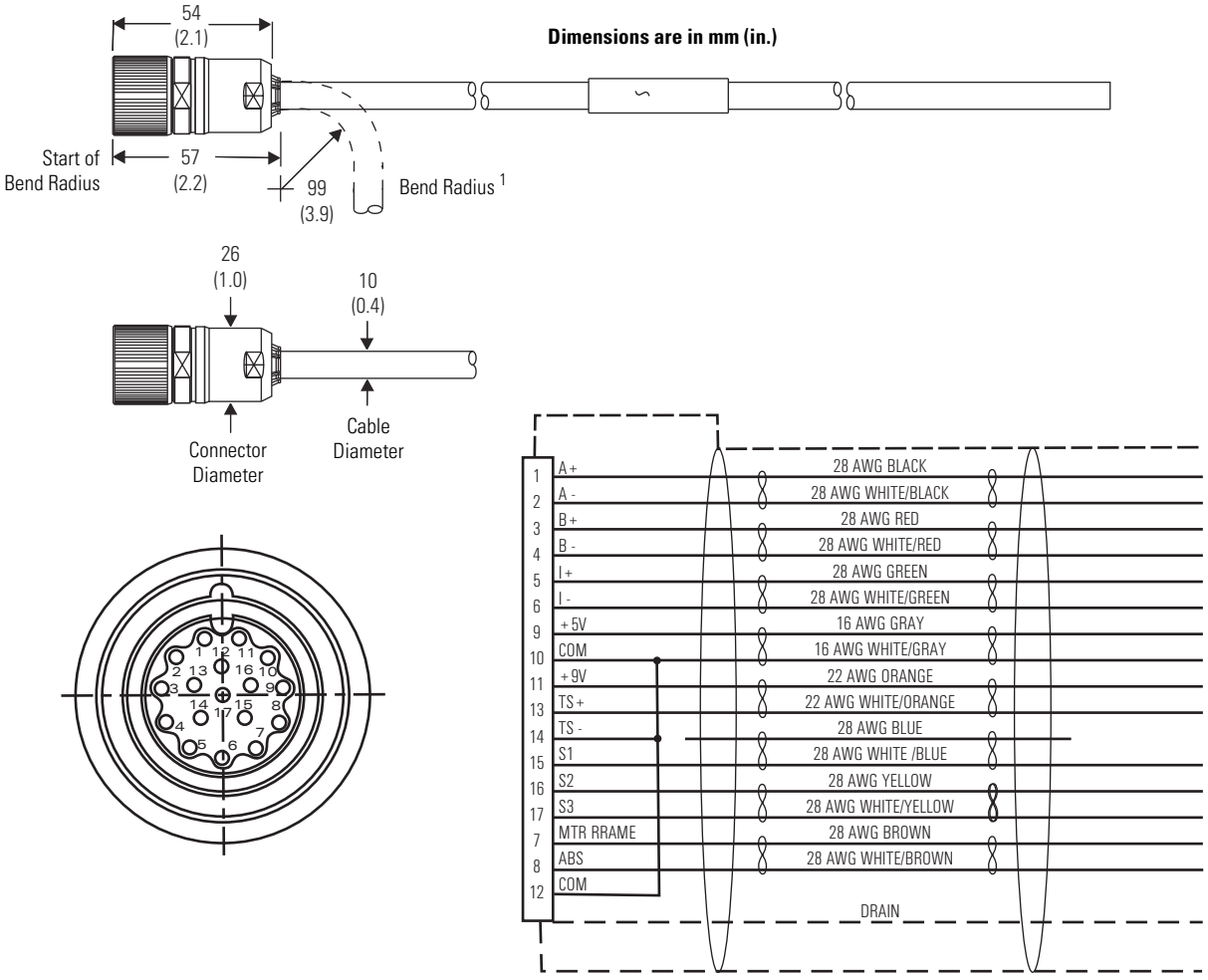
1 Bend radius (BR) is the specified minimum bend radius for cable assemblies. For standard cable, BR is a one-time flex application. Flex cables have a much higher BR to withstand flex applications. BR can vary on user-fabricated cables.

Pin	Gauge	Color	Signal Designation
A	16	Brown	U
B	16	Black	V
C	16	Blue	W
GND	16	Green/Yellow	GND

Pin	Gauge	Color	Signal Designation	
F	18	White	BR+	Not used for CHPS Stages
G	18	Black	BR-	
E	18	White	1	
H	18	Red	2	
L	N/A	N/A	N/A	
SHIELD				

Feedback Cable Dimensions (catalog number 2090-XXNFMF-S*xx*)

The maximum cable length of 10 m (32.8 ft).



1 Bend radius (BR) is the specified minimum bend radius for cable assemblies. For standard cable, BR is a one-time flex application. Flex cables have a much higher BR to withstand flex applications. BR can vary on user-fabricated cables.

Installation, Maintenance, and Replacement Kits

Accessories available for installing stages, replacing items, and performing maintenance at regular intervals are listed in the tables that follow.

Accessories

Description	Cat. No	Comments
Grease Pump Maintenance Kit	MPAS-GPUMP	Includes grease pump, one grease cartridge, and all necessary tips.
Grease Cartridge	MPAS-CART	Refill cartridge for grease pump.
Toe Clamp Installation Kit	MPAS-TOE	10 toe clamps per package
Tee Nut Installation Kit	MPAS-6-TNUT	10 Tee nuts per package
	MPAS-8-TNUT	
	MPAS-9-TNUT	
Cable Carrier Modules	MPAS-6xxxB-CABLE	xxx = cm stroke: 012, 018, 024, 030, 036, 042, 054, 066, 078, 090, 102, or 114
	MPAS-8xxxE-CABLE	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
	MPAS-9xxxK-CABLE	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
Strip Seal Replacement Kits	MPAS-6xxxB-SEAL	xxx = cm stroke: 012, 018, 024, 030, 036, 042, 054, 066, 078, 090, 102, or 114
	MPAS-8xxxE-SEAL	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
	MPAS-9xxxK-SEAL	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
Side Covers Replacement Kit	MPAS-6xxxB-SIDE	xxx = cm stroke: 012, 018, 024, 030, 036, 042, 054, 066, 078, 090, 102, or 114
	MPAS-8xxxE-SIDE	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
	MPAS-9xxxK-SIDE	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
Top Cover Replacement Kit	MPAS-6xxxB-TOP	xxx = cm stroke: 012, 018, 024, 030, 036, 042, 054, 066, 078, 090, 102, or 114
	MPAS-8xxxE-TOP	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194
	MPAS-9xxxK-TOP	xxx = cm stroke: 014, 020, 026, 032, 038, 044, 056, 068, 080, 092, 104, 128, 152, 176, or 194

Notes:

Stacking Stages

This appendix provides information about center-stacked stage configurations.

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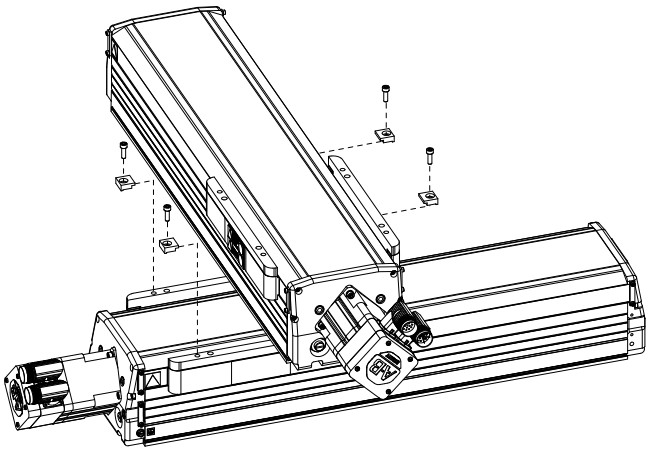
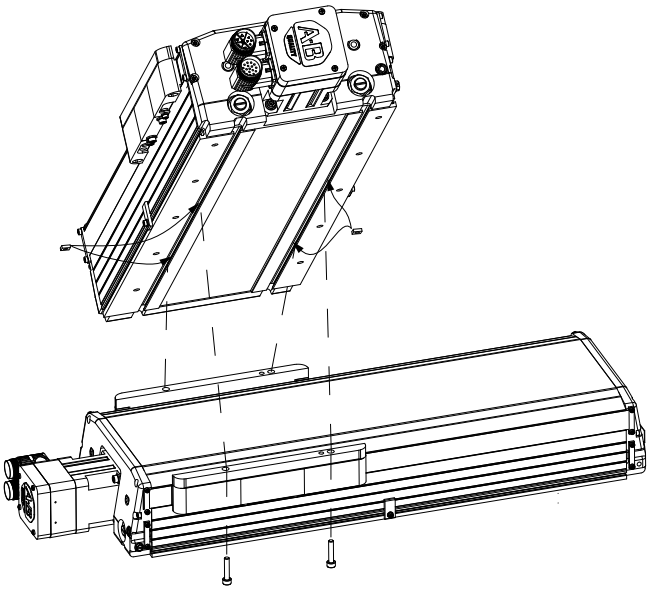
Stage Stacking

Certain combinations of MPAS linear stages are designed to be stacked on top of one another. Stacking forms an X-Y axis arrangement. A center-stack arrangement mounts the top axis in the middle of the bottom axis. The top stage is centered on the bottom stage.

Table 12 - Stacking Stages



The MPAS-x6xxxx is capable of mounting to the top of another MPAS-x6xxxx by bolting through toe-clamps to the slide on the bottom stage.



The MPAS-x8xxxx is capable of mounting to the top of either a MPAS-x8xxxx or a MPAS-x9xxxx by bolting through the slide on the bottom stage and into T-nut slots on the top stage.

Specifications for Stacked Stages

Linear stage specifications are based on mounting the stage to a precision base along the entire length of the stage, and MPAS stage specifications follow this convention. In the case of stacked stages, the top axis is no longer supported along its entire length, and this alters both the precision and the load carrying capability of that stage. Furthermore, linear stage specifications are based on a specified test payload with a low center of gravity that is centered on the carriage. Deviations from the test payload condition can impact the performance of both the top and bottom linear stages.

The following table provides information about the payload that the top stage, or axis, can carry without derating the life of its bearings from those specified for the same stage mounted as a single-axis stage on a precision base.

Table 13 - Centered Stack Combinations Not Requiring Derating

Catalog Numbers of Centered Stack Linear Stages	Y-axis Travel	Mass of Payload (1)
MPAS-*x6xxxx* on MPAS-*x6xxxx* Ball Screw or Direct Drive	300	10.0 kg (22 lb)
	420	8.0 kg (17.6 lb)
	540	5.0 kg (11 lb)
	660	4.0 kg (8.8 lb)
MPAS-*x8xxxx* on MPAS-*x8xxxx* Direct Drive	320	14.0 kg (30.8 lb)
	560	6.5 kg (14.3 lb)
	800	3.0 kg (6.6 lb)
MPAS-*x8xxxx* on MPAS-*x9xxxx* Direct Drive	320	14.0 kg (30.8 lb)
	560	6.5 kg (14.3 lb)
	800	3.0 kg (6.6 lb)
MPAS-*x8xxxx* on MPAS-*x8xxxx* Ball Screw	300	14.0 kg (30.8 lb)
	540	6.5 kg (14.3 lb)
	780	3.0 kg (6.6 lb)
MPAS-*x8xxxx* on MPAS-*x9xxxx* Ball Screw	300	14.0 kg (30.8 lb)
	540	6.5 kg (14.3 lb)
	780	3.0 kg (6.6 lb)

(1) Payload is based solely on bearing and structure limitations.

For other stacking arrangements, please contact Rockwell Automation Application Engineering.

Start-up Guide for CHPS-Series Stage with Ultra3000 Drive and Ultraware Software

This appendix is a supplement to CHPS-Series stage and Kinetix drive manuals. The information in the current product manuals supersedes this appendix.

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Wiring the CHPS-Series Stage to the Ultra3000 Drive	91
Linear Motor File Parameters	92
Creating a CHPS-Series Stage Motor File	92
Recommended Start-up Sequence	94
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Using This Appendix

This appendix is for use with CHPS-Series stages. This document addresses CHPS-Series stage-motor file parameter values and commutation wiring. Basic start-up test procedures and troubleshooting information is also given.

IMPORTANT Motor, commutation, feedback parameters, and wiring affect commutation, and must be correct for proper motor-drive operation. Improper setup can cause stage control problems including erratic behavior, bad spots, runaway, and thermal failure.

Wiring the CHPS-Series Stage to the Ultra3000 Drive

The CHPS-Series stage has four termination options. The Kinetix/MPF option is recommended for plug & play to Kinetix and Ultra family servo drives. Kinetix MPF interconnect cable makes it easy to wire the stage and set-up commutation with the Ultra3000 Drive. The wiring for non-Logix Ultra3000 drives and Logix® version Ultra3000 drives are the same.

If you are not using Kinetix/MPF termination option, properly wire the stage to the Ultra drive by using the following connectivity information. Refer to the CHPS-Series Stage Connector Data for additional information.

Connector Data Summary

CHPS-Series Stage Signal Designation	Ultra3000 Drive	
	Terminal or Pin	Signal Designation
Motor phase U	U	Motor phase U
Motor phase V	V	Motor phase V
Motor phase W	W	Motor phase W
Encoder A+ (digital) or Sin+ (analog)	CN2-1	Encoder A+ (digital) or Sin+ (analog)
Encoder A - (digital) or Sin - (analog)	CN2-2	Encoder A - (digital) or Sin - (analog)
Encoder B+ (digital) or Cos+ (analog)	CN2-3	Encoder B+ (digital) or Cos+ (analog)
Encoder B - (digital) or Cos - (analog)	CN2-4	Encoder B - (digital) or Cos - (analog)
Hall S1	CN2-12	Hall S1
Hall S2	CN2-13	Hall S2
Hall S3	CN2-8	Hall S3

Linear Motor File Parameters

The following guide supplements the information found in the Ultra3000 drive manuals. Some of the motor parameters are critical for commutation and motor protection. Incorrect entry of theses motor parameters can cause motor problems,

Ultraware assumes a linear motor is functionally equivalent to a rotary motor. However, the functional equivalent to a rotary motor is a complete linear motor driven stage. To account for the difference, the parameters highlighted in bold in the Linear Motor Parameter File (.mdb extension) table shown below must be adjusted to stage level specifications.

Creating a CHPS-Series Stage Motor File

Complete CHPS-Series stage motor specifications are in the linear motor specifications information contained in this manual or the motor's data sheet. Identify the stage motor option for your CHPS-Series stage and use the corresponding data.

Conversion Factors:

- Ultra3000 drive ampere units are measured at the peak of the sine wave, not RMS. Standard CHPS-Series stage motors are rated both ways. Be sure to select the correct value. If necessary, use the following conversion.

  ampere peak = 1.4 x RMS

- All Ultra drive electrical parameters are defined phase-to-phase. Standard CHPS-Series stage motors are specified phase-to-phase. If necessary, use the following conversion.

  phase-to-phase = 2 x phase-to-neutral

Table 14 - Linear Motor Parameter File (.mdb extension)

Parameter	Units	Enter	Comment
Force Constant	$N/A_{0\text{-peak}}$	Motor's linear region force constant	Convert if necessary. Standard CHPS-Series stage motors specify the correct unit value.
Mass	kg	Motor model coil mass	Standard CHPS-Series stages are intended for moving coil (slide) use.
Electrical Cycle Length	m	0.05 for LC motors or 0.06 for LZ motors	Standard CHPS-Series stage motors specify the electrical cycle length in mm. Electrical cycle equals 2 x magnet pitch.
Resistance	Ohms	Motor's cold resistance	Phase-to-phase directly from motor specifications.
Inductance	mH	Motor's inductance	Phase-to-phase directly from motor specifications.
Rated Voltage	V AC	Drive's input AC voltage.	LC motors are rated up to 460V AC. LZ motors are rated up to 230V AC. For stages with 0.1 um encoder option, the maximum drive input is 115V AC.
Flux Saturation table	—	—	Leave default values.
Maximum Speed	m/s	Lowest maximum velocity	Choose the lowest maximum velocity between the encoder or the application restriction. The encoder maximum velocity for the Ultra3000 drive is found in the CHPS-Series stage specifications.
Intermittent Current:	$A_{0\text{-peak}}$	Motor's peak current rating	Use the motor rating in the CHPS-Series Stage Selection Guide. Do not use the values from the Motor Product Profile. The CHPS-Series LZ motors are restricted to 3x continuous current. Consult with an application engineer if you are considering increasing this value.
Continuous Current	$A_{0\text{-peak}}$	Motor's continuous current rating	Use the motor rating in the CHPS-Series Stage Selection Guide. Do not use the values from the Motor Product Profile. For CHPS-Series stages with cover and seals option, derate the base value by 10%.
Max Current Boost	—	0%	For standard CHPS-Series stages without forced cooling.
Encoder Type	—	Select applicable type per CHPS-Series stage option code	Use Incremental for digital encoder or Sine/Cosine for analog encoder. Sine/Cosine requires additional set up per the Ultra3000 Drive manual.
Commutation Type	—	Sinusoidal	
Startup Type	—	Desired commutation mode	The recommended and default setting Hall Inputs and has no motion on startup. For self-sensing, refer to the section on Self-Sensing Commutation and Startup.
Hall Input Offset	degrees	0	For standard CHPS-Series stage motor models.
Lines/Meter	—		Enter the encoder lines per meter of travel. Lines are pre-quadrature resolution. Alternatively, for incremental encoders, calculate the counts/meter and divide by 4 to get lines/meter. Following are the values for the standard CHPS-Series stage encoders:
	lines/m	250,000	1 µm/count incremental
		500,000	0.5 µm/count incremental
		2,500,000	0.1 µm/count incremental
		12,500	Analog sin/cos, 20 µm period
Integral Limits	—	Unchecked	For the standard CHPS-Series stage limits option. The standard limits option is not compatible with the CN2 input circuit that expects an NPN open collector limit signal.
Integral Thermostat	—	Check	For the standard CHPS-Series stage motor options. The PTC thermistor signal is compatible with the Ultra3000 drive thermal input circuit. Except for very earliest Ultra Drives.

Table 14 - Linear Motor Parameter File (.mdb extension)

Parameter	Units	Enter	Comment
Software Protection	—	—	—
Thermal Protection Rth(w-a)	^{o}C /W	Calculate	The thermal resistance with the winding at ambient temperature: For LC motors, enter the rated thermal resistance value, multiply by 1.1 for covered and sealed stages. For 150 frame stage that use only LZ motor, enter the rated thermal resistance value. For 200 and 250 frame stages: LZ motors, enter 1.1x the rated thermal resistance value. In addition for all stages with LZ motors, multiply this value again by 1.1 for a covered and sealed stage.
Thermal Protection Cth(w-a)	W/s/ ^{o}C	Calculate	Energy absorption: Cth = tm/Rth where tm is the motor's thermal time constant in seconds. Leave the value as found if a valid LC or LZ file is used. If necessary, use the following tm values based on the heat sink size and cooling method: LC motors: tm = 1800 (seconds) LZ motors: tm = 1200 (seconds)

Recommended Start-up Sequence

Follow these steps for optimal motor commutation, performance, overcurrent, and overtemperature protection.

1. Set General Axis Parameters (.udb file extension)
   a. Auto Motor Iden = disabled for linear motors.
   b. Motor Model: select as needed.
   c. Total Moving Mass in kg = coil mass or magnet mass + moving structure mass+ moving cable assembly mass + customer load.
   d. Current Limits in Amperes peak - set as needed for the application. The drive uses the lowest value between the drive rating and the motor rating.
   e. Display Precision - Set to 2 decimal places.
   f. User Current Fault in Amperes peak - this is the continuous current. Set as needed for the application. The drive uses the lowest value between drive rating and the motor rating. To avoid nuisance tripping of the fast-acting protection, it can need to be set slightly higher.
2. Follow instructions from the standard drive manual and other applicable documentation. Pay special attention to electrical noise control by using cable shielding, shield termination, grounding, and bonding.
3. Wiring must match the CHPS-Series stage and Ultra drive connectivity table provided on page 92. Incorrect wiring or Hall offset combinations can result in motor motion that has excessive force ripple and increased current, temperature, or reduced force per unit of current.
4. Verify that the correct motor file is selected or correct custom motor parameter values are entered.
5. User Current Fault parameter - this value must not exceed the CHPS-Series stage motor's continuous current rating.

6. Current Limit parameters - the positive and negative current limit, must not exceed the CHPS-Series stage motor's intermittent current rating. Set per the application requirements.
7. Verify correct encoder polarity and test distance count. Encoder must count in positive direction when CHPS-Series stage is moving in the positive stage direction as shown in Stage Positive Direction on page 48. Also see CHPS-Series Stage and Ultra3000 Drive Troubleshooting Reference on page 96. Incorrect encoder sequencing can cause a runaway motor condition or incorrect commutation.
8. Perform Commutation Diagnostics only if enough free +/- travel distance is available. You can guarantee optimal commutation only by doing oscilloscope verification.

   You can use the following checks for non-optimal commutation verification. These tests cannot detect bad spots and other anomalies.

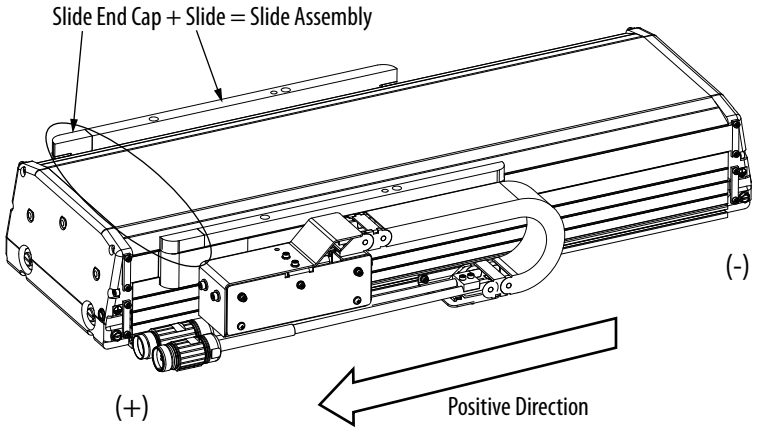
   - Use Current Control Panel mode to give a small positive current command. Verify the stage moves in the positive direction.
   - Check for consistent force resistance over whole travel by pushing the slide to multiple locations.
   - Check that the amount of current to move the load and overcome friction forces at a low steady speed are correct.
   - The motor's force constant (Kf) can also be verified with a force gauge. The Ultraware software command units for current scaling are in $A_{0\text{-peak}}/V$.
9. When current mode tests successfully, perform auto velocity or manual velocity tuning with the Ultraware oscilloscope function, do this even if you are using current mode to control your application. This further evaluates commutation and check for a good step response.

CHPS-Series Stage and Ultra3000 Drive Troubleshooting Reference

The section contains troubleshooting reference for the CHPS-Series stage and Ultra3000 drive combination.

Positive Phasing Direction

Positive stage direction = slide moving towards junction box or cable exit end as shown here.



Encoder Counting Polarity

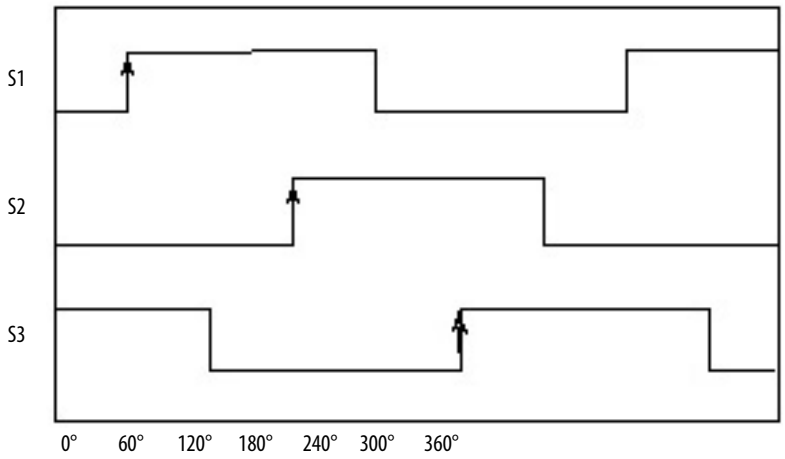
Encoder must count in positive direction when moving in the positive direction.

IMPORTANT	Incorrect encoder sequencing can cause a runaway motor condition or incorrect commutation.

Oscilloscope Verification

Correct stage and Ultra3000 drive wiring yields the phase relationship shown in Hall Oscilloscope Diagram.

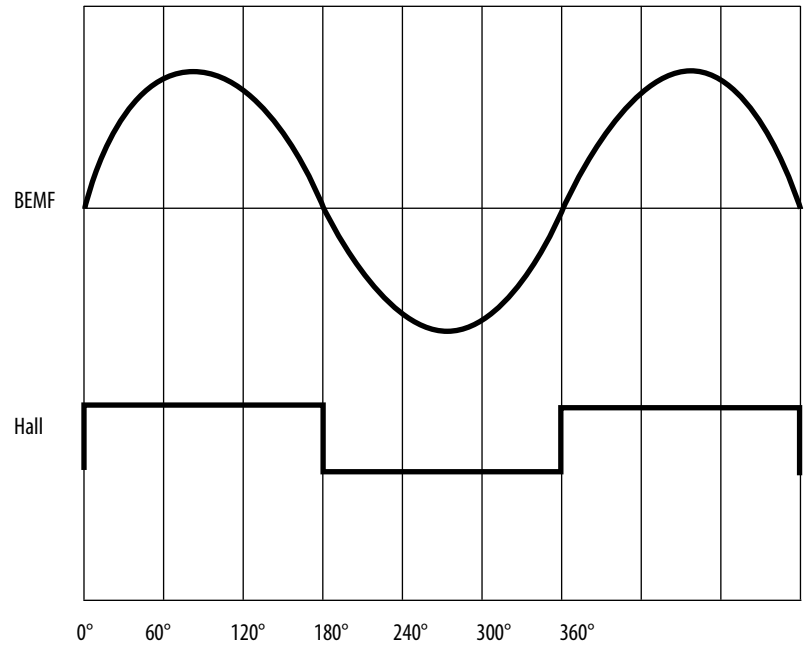
Figure 26 - Hall Oscilloscope Diagram



- Data capture direction - stage positive phasing direction as shown in Positive Phasing Direction on page 96.
- S1 leads S2 leads S3, 120° electrical spacing.
- For standard stages have following phase relationship:
  S1 in phase with W-U
  S2 in phase with U-V
  S3 in phase with V-W
- Hall probe GND to Hall common and, for W-U for example, coil probe tip = W and probe GND = U
- If wiring is correct the causes for incorrect phasing are:
  - non-standard coil or Hall assembly
  - coil electrical problem
  - Hall module electrical or mechanical problem

Oscilloscope Diagram for Ultra3000 Drive

Motor with Hall offset = 0°
While moving slide in positive direction.



Ultra Drive phasing pairs:

S1 vs. W-U	
S2 vs. U-V	Ultra3000 Drive
S3 vs. V-W	

Reference Information

Refer to these sections for information about the following:

- Commutation Diagnostics Utility
- Self-sensing Commutation and Startup
- Main Screen Setup
- Motor Screen
- Motor Screen
- Faults Screen

Commutation Diagnostics Utility

This test utility is intended for custom motors that do not have verified optimal phasing information. It can be used instead of the Ultraware oscilloscope based phasing method given in the Ultra3000 Drive Manual (1). The test utility can make false recommendations if the test set-up current level is too low, or an obstruction is encountered during the test motion. The CHPS-Series stage wiring must not deviate from the standard wiring. Do not use the utility if the free travel distance of the application is less than the required ± test motion.

These are the pre-test requirements.

1. Check for mechanical problems with the stage assembly.
2. Use a test current value high enough to overcome non-acceleration forces of stiction and friction, cable drag, magnetic attraction. A typical value used is 15...20%. But values as high as 40% can be necessary.
3. Verify the free travel range from motor starting position is at least two magnet pitches or 1 electrical cycle, in the negative direction, and four magnet pitches or 2 electrical cycles, in the positive direction.

(1) The phasing diagram in the drive manual is for phase-to-neutral measurements. This requires use of a balanced resistor Y network to create a virtual neutral. Alternatively, the phase-to-phase diagrams and procedures in the Ultra 100/200 can be used because they are equivalent to each other after the phase shift correction is made.

Self-sensing Commutation and Startup

This type of commutation does not use the Hall effect sensor. Motors with a Hall effect sensor connection can be set to self-sensing commutation, the Hall effect signals are ignored. Self-sensing start-up is not commutation diagnostics. You can perform commutation diagnostics at any time on Hall effect or self-sensing motors. Self-sensing start-up refers to the motor motion initialization that is executed automatically after every power-up and enabling of the system. It synchronizes the arbitrary encoder position or count to the drive's initial commutation angle.

This is the self-sensing start-up sequence:

- Enable is activated.
- Motor locks into detent or zero force position > up to ± one magnet pitch (½ electrical cycle) of motion jerk.
- After jerk motion settles out in 1 or 2 seconds, motor executes a slow speed test move of approximately two magnet pitches or one electrical cycle in the positive direction.
- Drive disables, ready for normal operation.

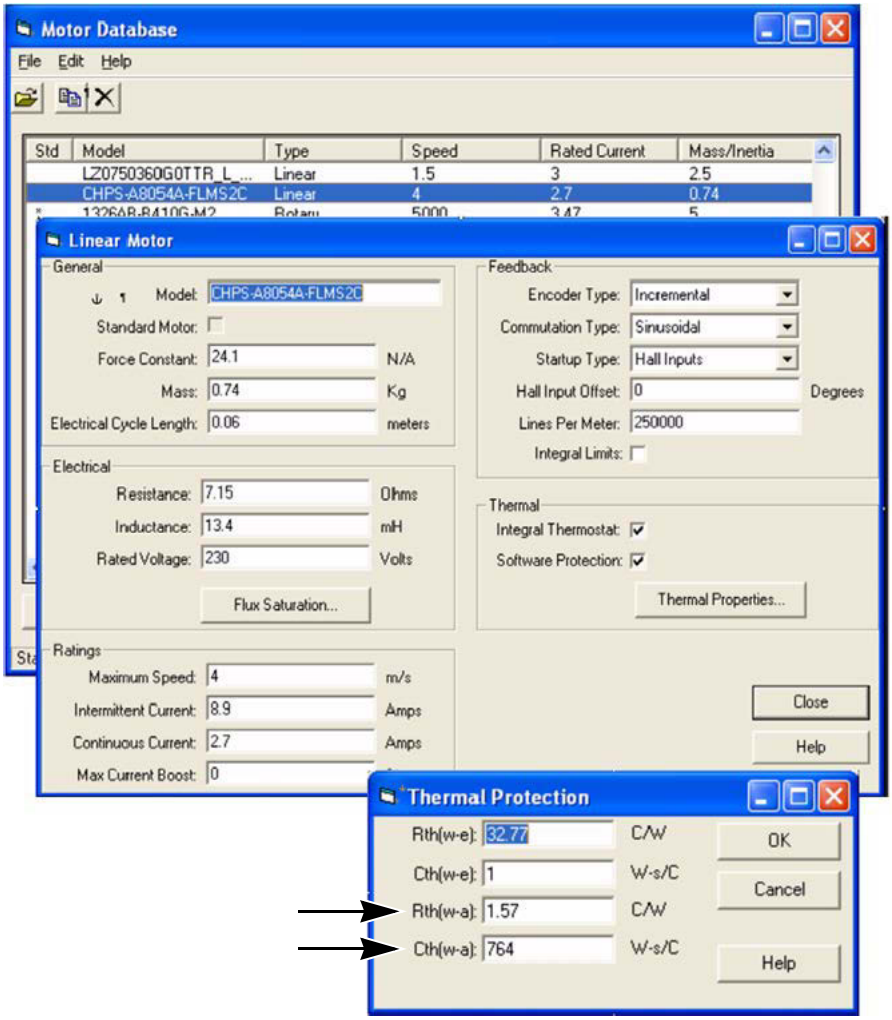
During this startup, the drive evaluates the test motion. A fault indicates that the motor motion was not as expected. Possible reasons include the following:

- Mechanical problem with the stage such as excessive stiction, friction, or cable drag.
- Obstruction during test motion.
- Incorrect coil or encoder wiring.
- Encoder or signal problems, device fault, wiring problem, noise.
- During startup, the drive uses a fixed 1/6 of the peak motor or drive current, whichever is lower.

Ultraware software version 1.3 with firmware revision 1.16 (or greater) has improved functionality with proper alignment under any single obstruction:

- If during the positive test move, after detent, an obstruction is encountered, a test move is done in the opposite direction after re-initializing the new detent.
- If an obstruction prevents the motor from going to the real detent, for example, detent past negative hard stop, the Ultra drive senses a false detent during the test move due to false alignment. After re-initializing of the new detent a second test move is done in the positive direction.
- The self-sensing routine can take 2x longer because of obstructions.
- If a second obstruction is detected during whole routine, such as low test current or too high friction, the test faults.
- The new versions lets a user programmable test current value.
- Limit signals sent to the Ultra Drive are ignored during self-sensing start-up.

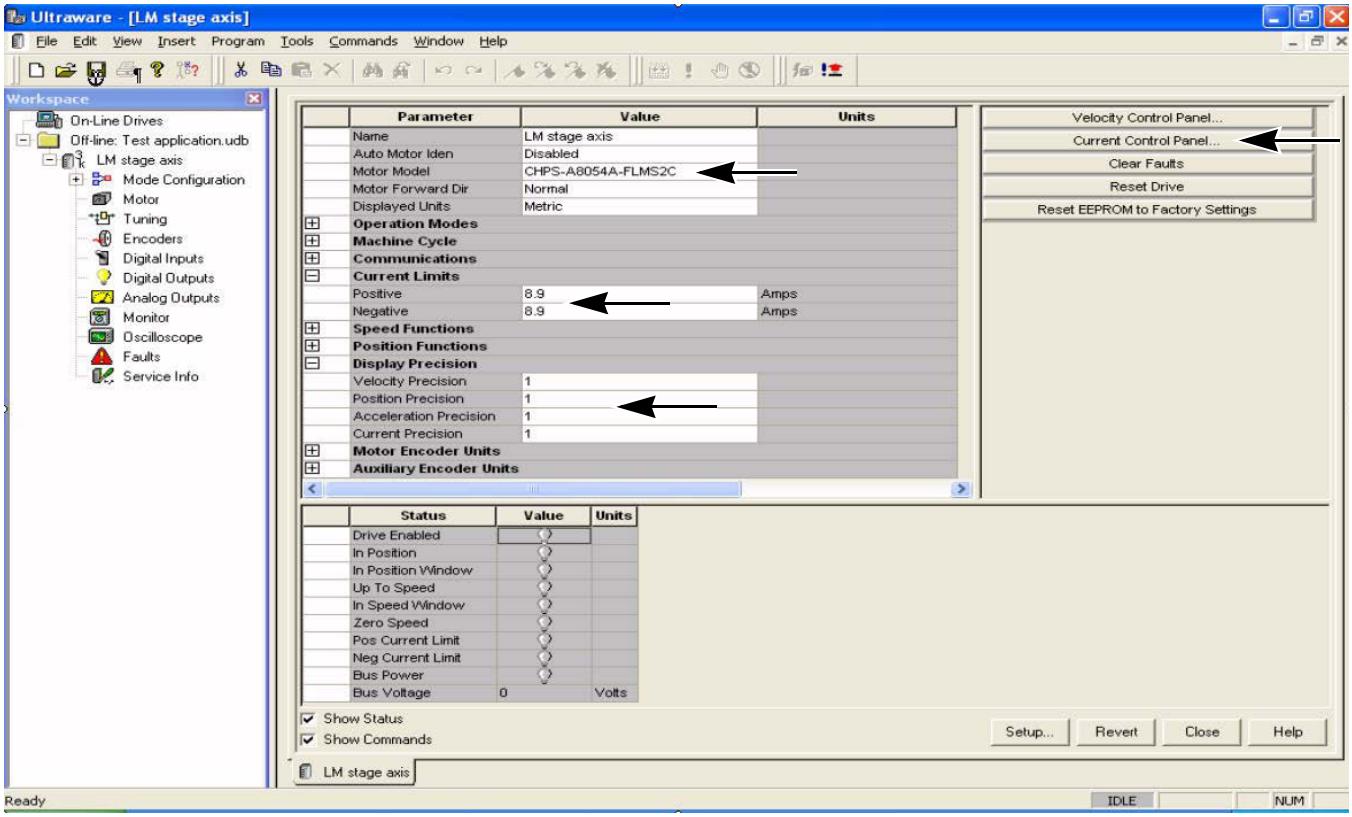
The following in an example of a CHPS-Series stage custom motor file created in Ultraware Motor Database utility.



For linear stages with a size 200 frame, LZ-030-T-120-D linear motor, 1 µm encoder, cover/seals, and no integral limits.

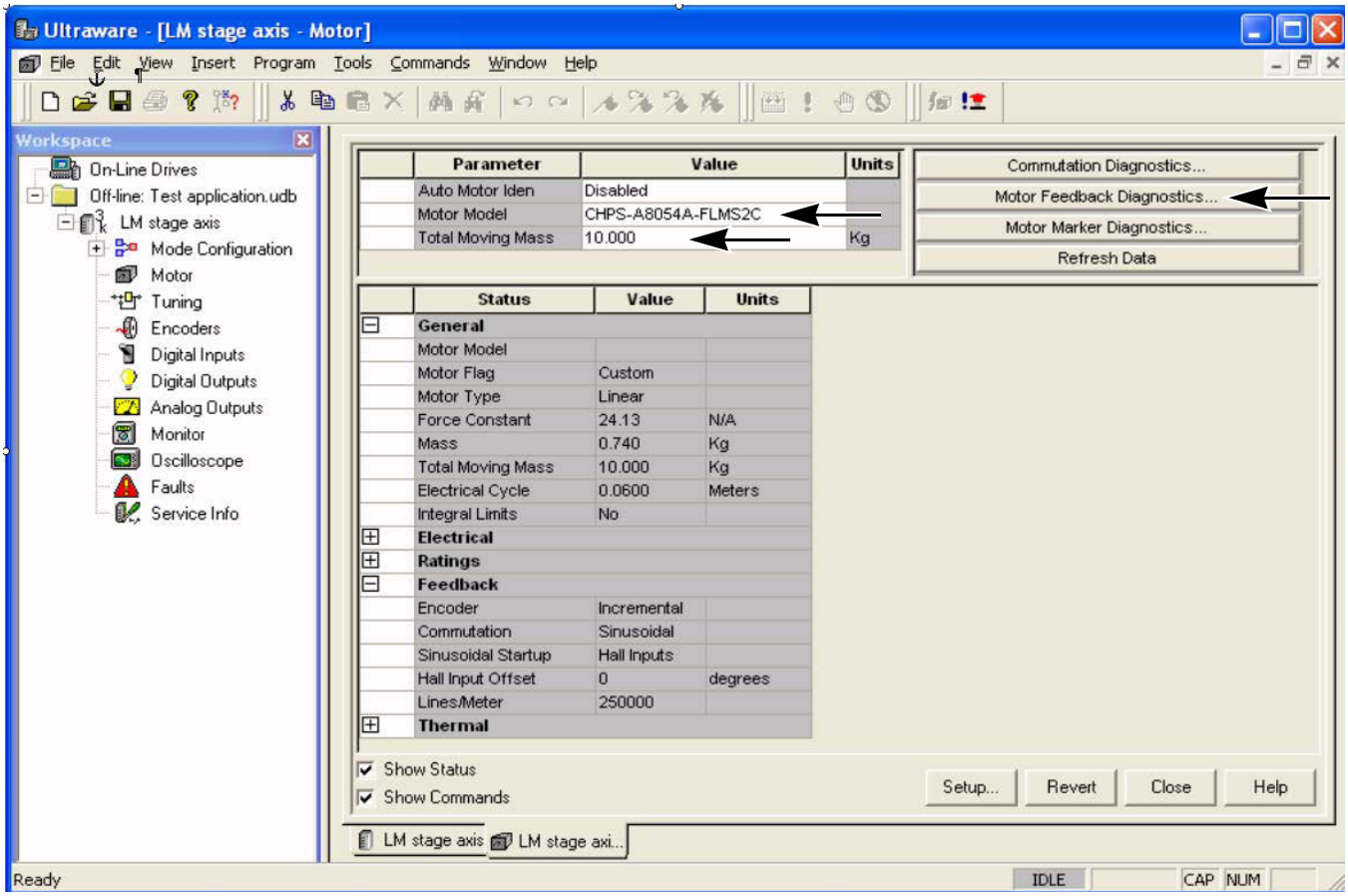
Main Screen Setup

On this screen, enter CHPS-Series stage motor file, Current Limits not-to-exceed motor file, Display Precision, and access the Current Control Panel.



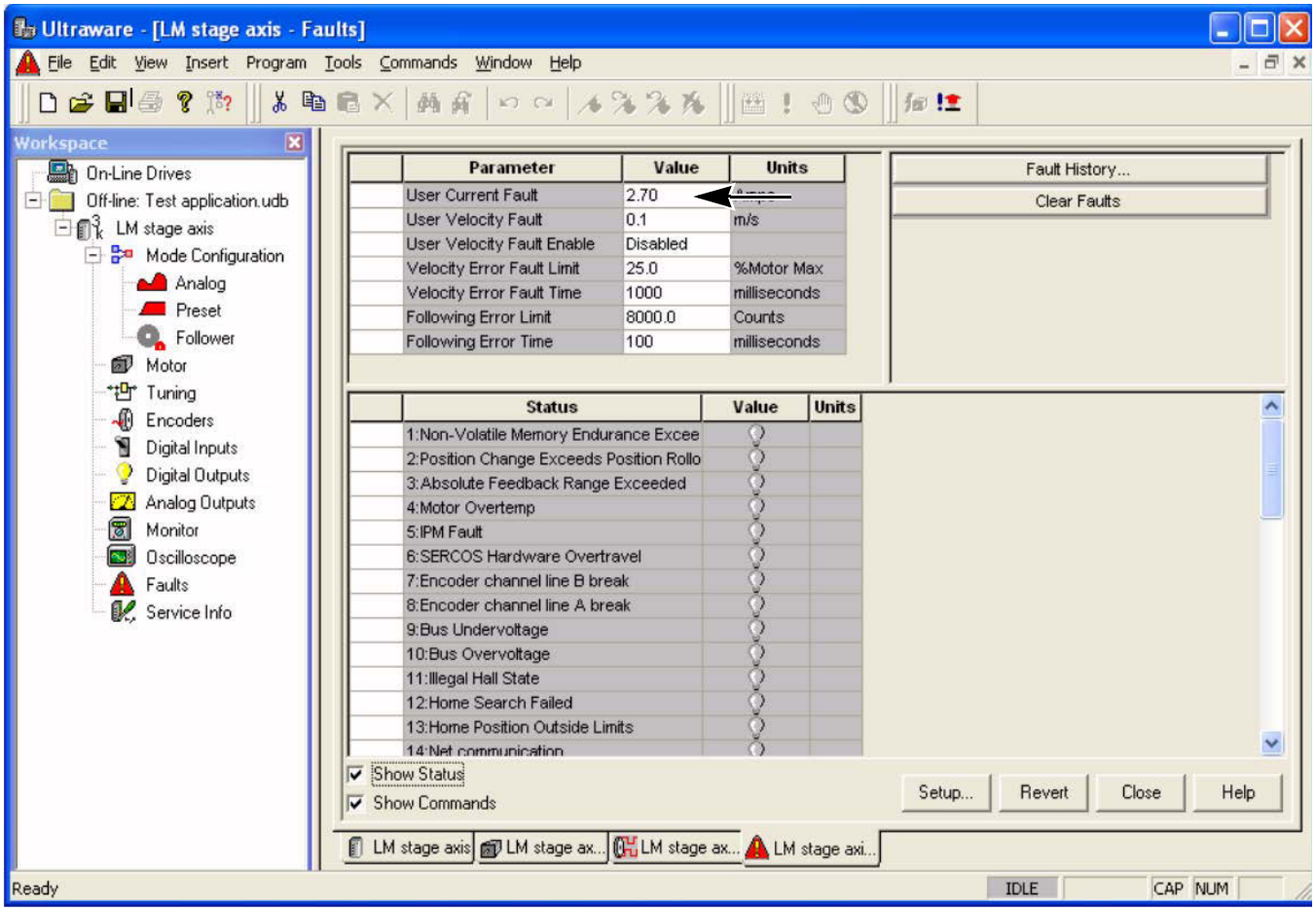
Motor Screen

On this screen, enter Total Moving Mass, check for correct Motor Model and parameters, and access the Motor Feedback Diagnostics Utility.



Faults Screen

On this screen, enter the continuous current in User Current Fault field, not to exceed the motor file continuous current value.



Mounting Bolts and Torque Values

Table 15 - Recommended Seating Torque for Metric Bolts

Bolt Size (Metric) [1]	Pitch	Plain N•m (lbf•in)	Cadmium Plated N•m (lbf•in)	Zinc N•m (lbf•in)
M1.6 [2]	0.35	0.29 (2.6)	0.22 (1.95)	0.41(3.64)
M2 [2]	0.40	0.60 (5.3)	0.45 (3.98)	0.84 (7.42)
M2.5 [2]	0.45	1.24 (11)	0.93 (8.25)	1.74 (15.4)
M3	0.5	2.15 (19)	1.61 (14.25)	3.00 (26.6)
M4	0.7	4.6 (41)	3.47 (30.75)	6.48 (57.4)
M5	0.8	9.6 (85)	7.20 (63.75)	13.4 (119)
M6	1.0	15.8 (140)	11.9 (105)	22.1 (196)
M8	1.25	39.5 (350)	29.7 (262.5)	55.4 (490)
M10	1.5	76.8 (680)	57.6 (510)	115.2 (1020)

(1) Mounting hardware is ISO 898/1 socket head cap bolt that meets or exceeds ANSI B113M, ISO 261, ISO 262 (coarse series only).
(2) Microsize bolt.

Table 16 - Recommended Seating Torque for Mild Steel Rb 87 or Cast Iron Rb 83

	UNC		UNF	
	Plain	**Cadmium Plated**	**Plain**	**Cadmium Plated**
Bolt Size [1], [2]	N•m (lbf•in)	N•m (lbf•in)	N•m (lbf•in)	N•m (lbf•in)
#0	—	—	0.24 (2.1) [3]	0.18 (1.6) [3]
#1	0.44 (3.89) [3]	0.53 (4.7) [3]	0.46 (4.1) [3]	0.34 (3.0) [3]
#2	0.71 (6.3) [3]	0.53 (4.7) [3]	0.76 (6.8) [3]	0.58 (5.1) [3]
#3	1.08 (9.6) [3]	0.81 (7.2) [3]	1.16 (10.3) [3]	0.87 (7.7) [3]
#4	1.52 (13.5) [3]	1.13 (10) [3]	1.67 (14.8) [3]	1.2 (11) [3]
#5	2.3 (20) [3]	1.7 (15) [3]	2.37 (21) [3]	1.8 (16) [3]
#6	2.8 (25) [3]	2.1 (19) [3]	3.2 (28) [3]	2.4 (21) [3]
#8	5.2 (46) [3]	3.8 (34) [3]	5.4 (48) [3]	4.1 (36) [3]
#10	7.6 (67) [3]	5.6 (50) [3]	8.6 (76) [3]	6.4 (57) [3]
1/4	17.8 (158) [3]	13.4 (119) [3]	20.3 (180) [3]	15.4 (136) [3]
5/16	36.8 (326) [3]	27.7 (245) [3]	40.7 (360) [3]	30.5 (270) [3]
3/8	65.5 (580) [3]	49.1 (435)	71.7 (635)	53.7 (476)
7/16	105 (930) [3]	78.9 (698) [3]	117.5 (1,040) [3]	88.1 (780) [3]
1/2	160 (1,420) [3]	172.8 (1,530) [3]	254.2 (2,250)	190.9 (1,690)) [3]

(1) Mounting hardware is 1960-series socket head cap bolt that meets or exceeds ANSI B18.3.
(2) Torque is based on 80,000 psi bearing stress under the head of the bolt.
(3) Denotes torque based on 100,000 psi tensile stress, with threads up to one inch in diameter.

Table 17 - Recommended Seating Torque for Brass Rb 72

	UNC		UNF	
	Plain	**Cadmium Plated**	**Plain**	**Cadmium Plated**
Bolt Size (1), (2)	N•m (lbf•in)	N•m (lbf•in)	N•m (lbf•in)	N•m (lbf•in)
#0	—	—	0.24 (2.1) (3)	0.18 (1.6) (3)
#1	0.43(3.8) (3)	0.33 (2.9) (3)	0.46 (4.1)	0.34 (3.0) (3)
#2	0.71 (6.3) (3)	0.53 (4.7) (3)	0.77 (6.8) (3)	0.58 (5.1) (3)
#3	1.08 (9.6) (3)	0.81 (7.2) (3)	1.16 (10.3) (3)	0.87 (7.7) (3)
#4	1.52 (13.5) (3)	1.1 (10) (3)	1.67 (14.8) (3)	1.24 (11) (3)
#5	2.2 (20) (3)	1.7 (15) (3)	2.4 (21) (3)	1.8 (16) (3)
#6	2.8 (25) (3)	2.1 (19) (3)	3.2 (28) (3)	2.4 (21) (3)
#8	5.2 (46) (3)	3.8 (34)	5.4 (48) (3)	4.1 (36) (3)
#10	7.6 (67) (3)	5.6 (50) (3)	8.6 (76) (3)	6.4 (57) (3)
1/4	15.3 (136)	11.5 (102)	15.4 (136)	11.5 (102)
5/16	25.8 (228)	19.3 (171)	25.8 (228)	19.3 (171)
3/8	53.7 (476)	40.3 (357)	53.7 (476)	40.3 (357)
7/16	76.8 (680)	57.6 (510)	76.8 (680)	57.6 (510)

(1) Mounting hardware is 1960-series socket head cap bolt that meets or exceeds ANSI B18.3.
(2) Torque is based on 60,000 psi bearing stress under the head of the bolt.
(3) Denotes torques based on 100,000 psi tensile stress with threads up to one inch in diameter.

Table 18 - Recommended Seating Torque for Aluminum Rb 72 (2024-T_4)

	UNC		UNF	
	Plain	**Cadmium Plated**	**Plain**	**Cadmium Plated**
Bolt Size [(1), (2)]	N•m (lbf•in)	N•m (lbf•in)	N•m (lbf•in)	N•m (lbf•in)
#0	—	—	0.24 (2.1) [(3)]	0.18 (1.6) [(3)]
#1	0.44 (3.8) [(3)]	0.33 (2.9) [(3)]	0.46 (4.1) [(3)]	0.34 3.0v
#2	0.71 (6.3) [(3)]	0.53 (4.7) [(3)]	0.77 (6.8) [(3)]	0.58 (5.1) [(3)]
#3	1.08 (9.6) [(3)]	0.81 (7.2) [(3)]	1.16 (10.3) [(3)]	0.87 (7.7) [(3)]
#4	1.52 (13.5) [(3)]	1.1 (10) [(3)]	1.67 (14.8) [(3)]	1.24 (11) [(3)]
#5	2.3 (20) [(3)]	1.7 (15) [(3)]	2.37 (21) [(3)]	1.8 (16) [(3)]
#6	2.8 (25) [(3)]	2.1 (19) [(3)]	3.2 (28) [(3)]	2.37 (21) [(3)]
#8	5.2 (46) [(3)]	3.8 (34) [(3)]	3.2 (48) [(3)]	4.1 (36) [(3)]
#10	7.6 (67) [(3)]	5.6 (50) [(3)]	8. 6 (76) [(3)]	6.4 (57) [(3)]
1/4	12.8 (113)	9.6 (85)	12.8 (113)	9.6 (85)
5/16	21.5 (190)	16.1 (143)	21.5 (190)	16.1 (143)
3/8	44.8 (397)	33.6 (298)	44.8 (397)	33.7 (298)
7/16	64.4 (570)	48.0 (425)	64.4 (570)	48.0 (425)
1/2	159.3 (1,410)	119.8 (1,060)	159.3 (1,410)	119.8 (1,060)

(1) Mounting hardware is 1960-series socket head cap bolt that meets or exceeds ANSI B18.3.
(2) Torque is based on 50,000 psi bearing stress under the head of the bolt.
(3) Denotes torques based on 100,000 psi tensile stress with threads up to one inch in diameter.

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Notes:

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